

Topics to be covered:

- Reduction of an ER and EER diagram into Tables

2.10 REDUCTION OF AN E-R AND EER DIAGRAM INTO TABLES

To represent the database in tabular form, E-R diagrams have to be reduced in tables.

For each entity set, make different table and for each relationship set make a different table.

2.10.1 Reduction of Strong Entity Sets into Tables

For a strong entity set E with attributes a_1, a_2, \dots, a_n , make a table having same name as of entity set E and having n number of columns or table name is equal to entity set name and number of columns is equal to number of attributes. Consider the Figure 2.20 having strong entity set Department with two attributes Dept-ID and Dept-name.

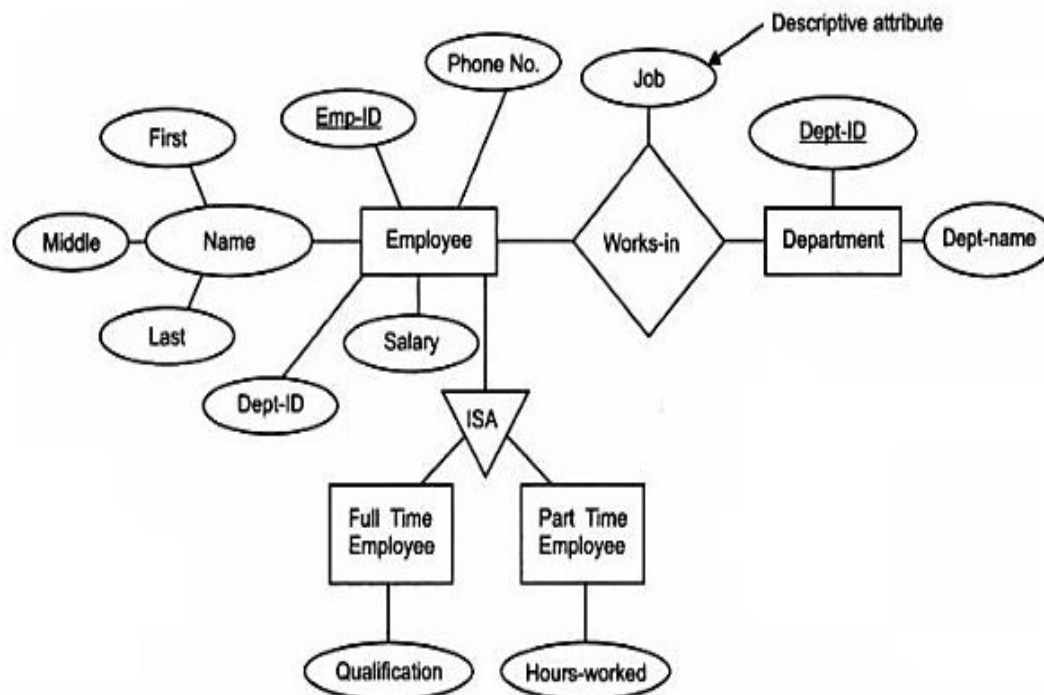


FIGURE 2.20. E-R model of employee and department entity sets.

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The corresponding table is shown in Figure 2.21 with table name Department and two columns, Dept_ID and Dept_name.

Department

Dept-ID	Dept-name
10	Sales
20	Development
30	Testing
40	Accounts

FIGURE 2.21. The department table (Reduction of strong entity set).

2.10.2 Reduction of Composite Attributes

For a composite attribute, create a separate column for each component attribute or parts of composite attributes. Consider the example shown in Figure 2.20. The Name is a composite attribute with three component attributes First, Middle and Last. So, make three columns First-name, Middle-name and Last-name. The corresponding table is shown in Figure 2.22.

EID-ID	First-name	Middle-name	Last-name	Salary	Dept-ID
A 12	Deepak	Kumar	Goyal	15,000	10
S 50	Shivi	—	Goyal	75,000	20
51 C	Anu	—	Parmar	8,000	10
67 B	Ravi	—	—	5,000	40

FIGURE 2.22. The employee table (Reduction of composite attributes).

2.10.3 Reduction of Multi-valued Attributes

For multi-valued attributes, make a separate table with columns C1 which represent the primary key of entity set or relationship set and with columns C2 which represent the multi-valued attributes. Rows are equal to total number of values of that attribute. Consider Figure 2.20 in which Phone-No. is multi-valued attribute. So, make a table with two columns, one is Emp-ID (primary key of Employee) and second is Phone-No. (multi-valued attribute). Give any name to that table. The table is shown in Figure 2.23. If any employee has two phone numbers then it is possible to make two different entries in table and so on.

Emp-ID	Phone-No.
A-12	23896
A-12	23897
51-C	38976
51-C	23551
51-C	98941
67-B	23999

FIGURE 2.23. The phone-number table (Reduction of multi-valued attributes).

2.10.4 Reduction of Weak Entity Sets

Let A be the weak entity set and B be the strong entity set on which A depends. Then, it is possible to make a table with table name as of Weak Entity Set having columns equal to the

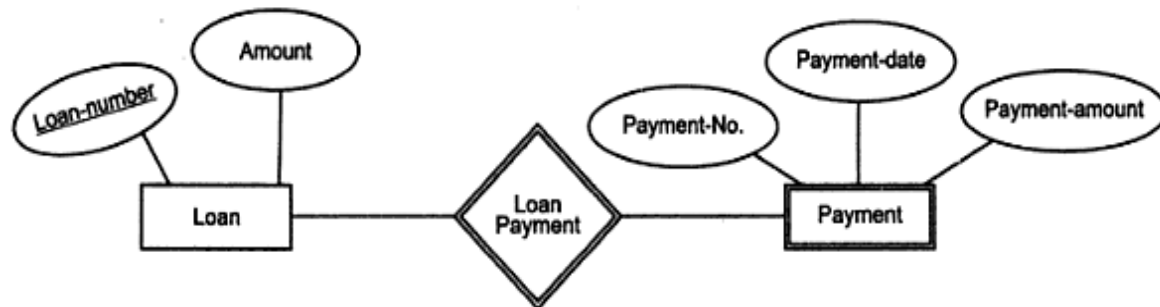


FIGURE 2.24. E-R diagram of weak entity set payment.

attributes of Weak Entity set plus Primary Key of the Strong Entity set on which Weak Entity Set depends. Consider the E-R diagram shown in Figure 2.24, in which Payment is a Weak entity set that depends upon Loan entity set. So, make a table with table name Payment having four columns as shown in Figure 2.25.

Payment

Loan-number	Payment-No.	Payment-date	Payment-amount
E-12	2	19-2-2004	6912
C-55	5	31-1-2005	5000
H-96	11	2-2-2005	2000
P-77	2	6-9-2005	2500

FIGURE 2.25. The payment table (Reduction of weak entity set).

2.10.5 Reduction of Relationship Sets

Let R be the relationship set and E1, E2, ..., EN be the entity sets participating in R. Make a table with table name as of Relationship Set having columns equal to number of attributes in relationship set (descriptive attributes) and primary keys of all participating entity sets.

Consider the ER diagram shown in Figure 2.20, having relationship set works-in having two participating entity sets, Employee and Department. The corresponding table is shown in Figure 2.26.

Works-in

Emp-ID	Dept-ID	Job
S-50	20	Engineer
A-12	10	Salesman
51-C	10	Salesman
67-B	40	Accountant

FIGURE 2.26. The works-in table (Reduction of relationship sets).

2.10.5.1 Redundant Tables

The relationship set between weak and strong entity sets are treated specially. Consider the E-R diagram shown in Figure 2.24, where weak entity set, Payment depends on strong entity set Loan having relationship set loan-payment. Primary key of Entity set Loan is [loan-number] and of Weak entity set is [loan-number, payment-number]. Table of entity set Payment has four attributes [loan-number, payment-number, Payment-date, payment-amount]. If you make table of relationship set loan-payment then it contains attributes [loan-number, payment-number]. This combination is already present in table of Payment. Even, there are no descriptive attributes. So, this table is redundant and discard it.

2.10.5.2 Combination of Tables

Consider two entity sets X and Y connecting with relationship set XY. The n , three tables named X, Y and XY have to be made. If cardinality ratio between X and Y is many-to-many and X is totally participated then, combine tables X and XY. Consider the E-R diagram shown in Figure 2.27, having two entity sets, Customer and Loan. The relationship is many-to-many because a customer can take many loans and a single loan can be taken by more than one customer or joint loan. Loan entity set is totally participated because every loan refers to some customer. So, combine tables Loan and Borrower. But loan cannot exist with any customer so two tables are needed i.e.,

- Loan [loan-number, amount, customer-ID, Income]
- Customer [Customer-ID, Name]

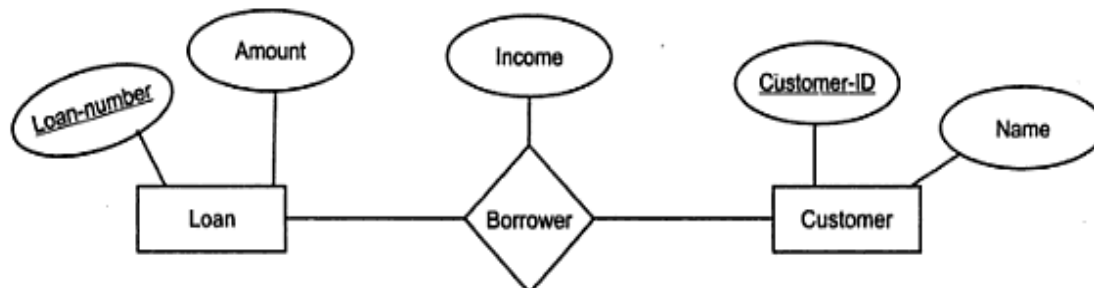


FIGURE 2.27. Combination of tables.

2.10.6 Reduction of Generalization

In generalizations, higher level entity sets and lower level entity sets are considered. Make a table for higher level entity set with all its attributes. For lower level entity set, make a table with all its attributes with primary key attributes of its higher level entity set. Consider E-R diagram shown in Figure 2.20, in which Employee is high level entity set and Full Time Employee and Part Time Employee are two lower level entity sets. So, make three tables as given below:

- Employee [Emp-ID, Dept-ID, First-Name, Middle-Name, Last-Name, Salary]
- Full Time Employee [Emp-ID, Qualification]
- Part Time Employee [Emp-ID, Hours-Worked]

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2.9.5 Aggregation

Aggregation is an abstraction process in which a relationship set is considered as higher level entity set.

Consider an example of ternary relationship having three entity sets Employee, Job and Branch with relationship set works-on as shown in Figure 2.16. The information about Managers on employees, managers of particular jobs and of different branches can be taken easily.

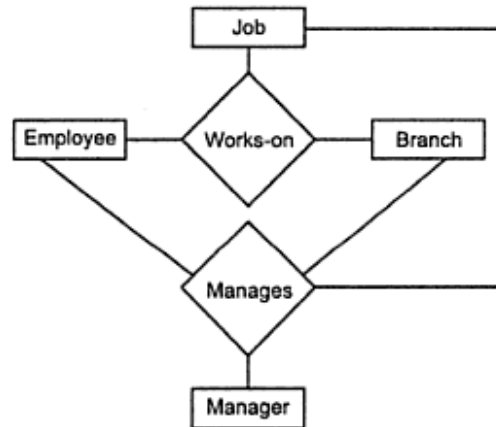


FIGURE 2.16. E-R model.

You cannot combine works-on and managers relationship sets because some workers are not managers. Using aggregation, works-on relationship set acts as higher entity set and solve this drawback of E-R Model. E-R Model with Aggregation is shown in Figure 2.19.

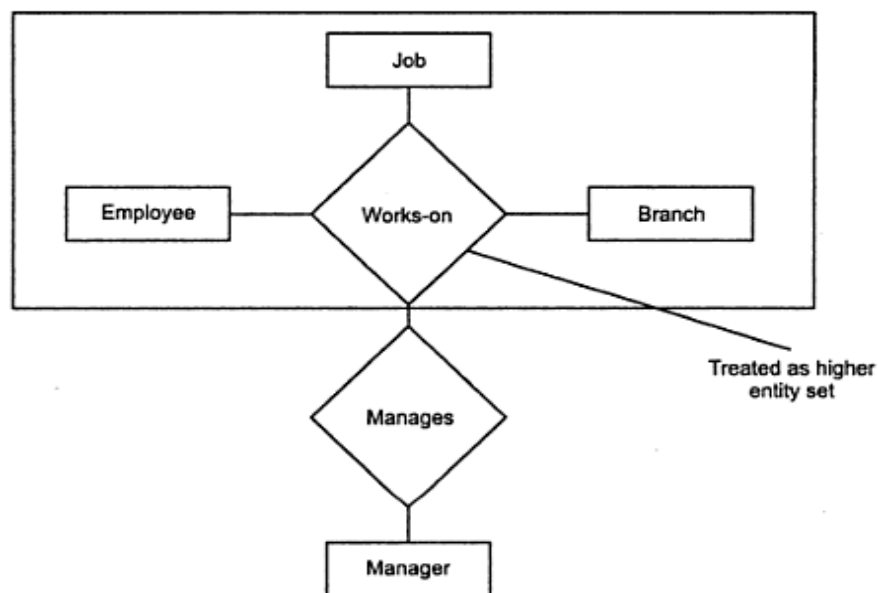


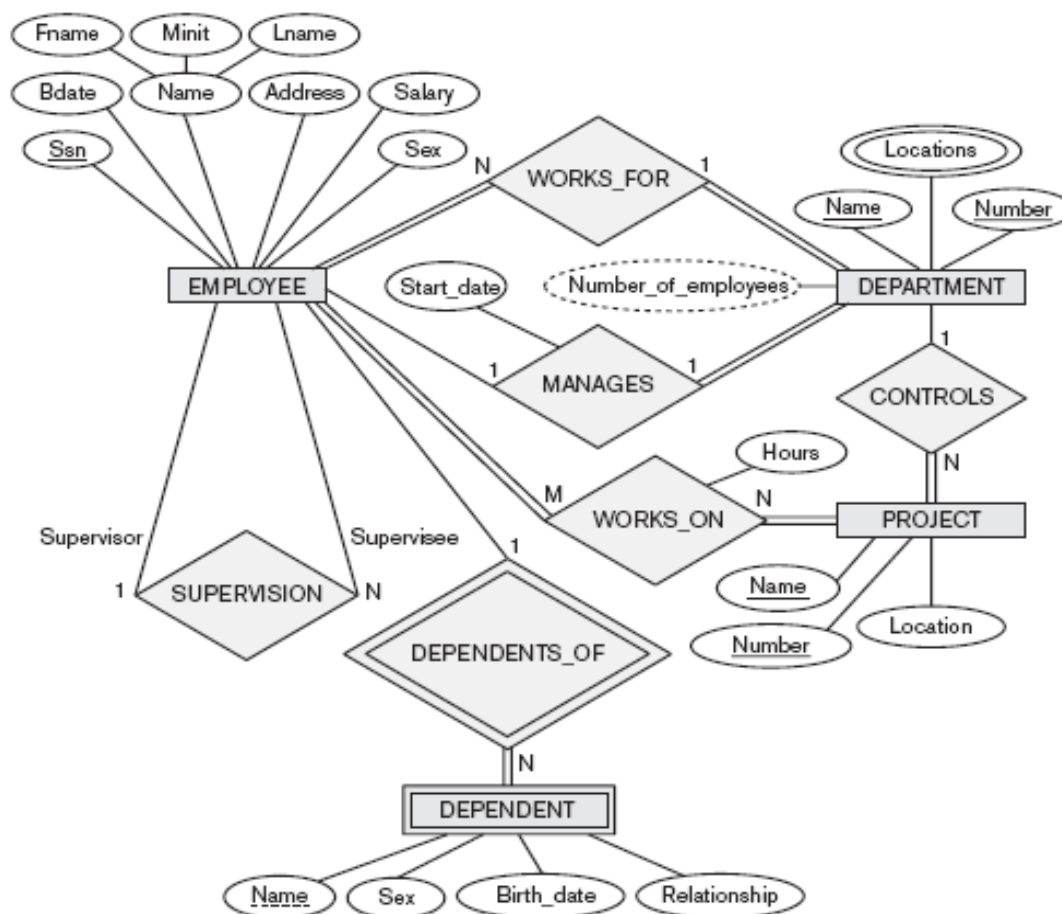
FIGURE 2.19. E-R model with aggregation.

2.10.7 Reduction of Aggregation

Reduction of aggregation into tables is simple. Consider the E-R diagram shown in Figure 2.19. For all entity sets, make tables as discussed earlier. For making tables for relationship sets, consider the same approach as discussed earlier. Take an example of relationship set Manages. Make a table manages with all descriptive attributes, primary key of entity set Manager and the relationship set works-on.

Long Answer Type Questions:

1. What are the rules to convert ER and EER diagram into Relational model.
2. From the given problem statement (it could be any business problem e.g. Banking system, Hospital management system etc.), draw an ER diagram and convert it into relational model.
3. Convert below ER diagram into Relational Model.



Solution for Q.3:

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EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1985-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	838 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelays	999887777	1988-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Barry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	888664444	1982-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1989-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
888664444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1988-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1987-05-05	Spouse