Chapter-2.

DATA MODELS.

Data Models:-

Data Models are the useful tools for database design. It is the sets of concept to describe the structure of the database and the certain constraints that the database should follow.

Levels of Data Modelling:-

Feature	Conceptual	Logical	Physical
Entity names	✓	✓	
Entity relationship	✓	✓	
Attributes		✓	
Primary keys		✓	✓
Foreign keys		✓	✓
Table names			✓
column names			✓
Column Data Types			✓

1) Conceptual data model:-

It identifies the highest level relationship between different entities. It mainly includes entity name and entity relationship.

2) Logical data model:-

A logical data model describes the data in as

much detail as possible without the decision of how they will be implemented in the physical databases. It generally includes entity names, entity relationship, attribute primary key and foreign key.

3) Physical data models:-
The physical data model represent how the model will be build. A physical database model shows all table structure including column name, column data type, column constraints, primary key.

Types of DBMS database models:-
A database model defines the logical design and structure of a database and defines how data will be stored, accessed and updated in a DBMS. Although relational model is the most widely used model, there are other models too.

v. imp
1) Hierarchial model
2) Network model
3) ER model (Entity Relationship)

1) Hierarchial model:-
- It organizes data into a tree like structure, with a single root to which all the other data are linked.
- This model efficiently describe many real world relationship like file system in devices, index of a book etc.
- In hierarchial model, data is organized into tree like

structure with one-to-many relationship between different types of data. For e.g: a department of a college can have many courses.

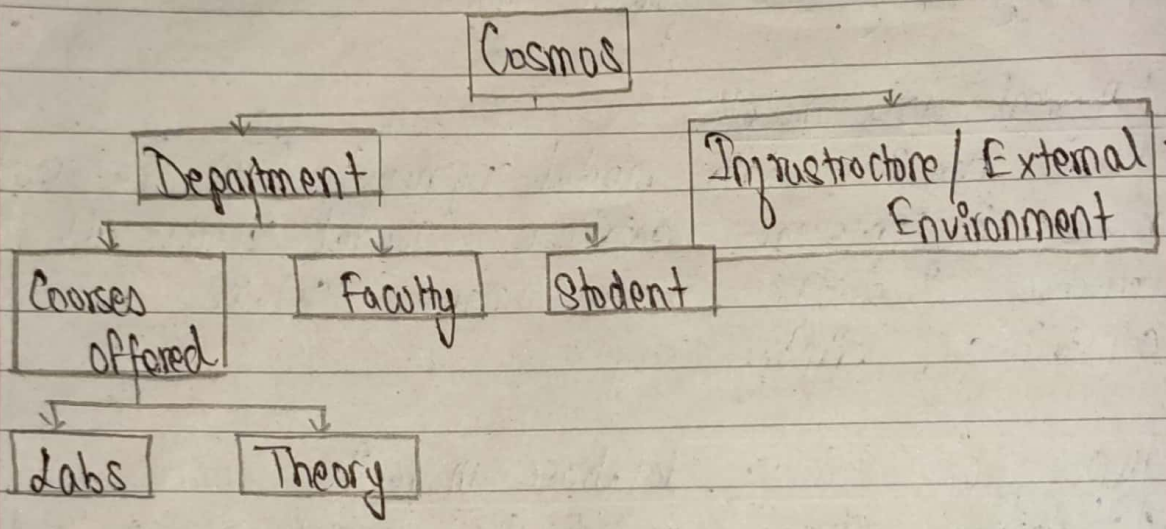


Fig: Hierarchical model

2) Network model:-

This is an extension of hierarchical model and the data is organised more like a graph and are allowed to have more than one parent.

In this type of model the data are more related as more relationship are established within the database.

E.g.

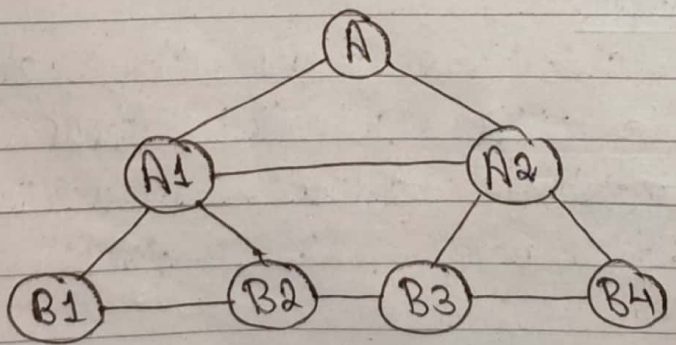


Fig: Network model.

Imp. 3) Entity model (ER) :-

ER model, also called entity relationship model is a high level data modeling tool and is based on the perception that database consist of basic objects (called entity) and relationship exists among those objects.

Entity - An entity is an object that exists and can be differentiated from other object. E.g. Student, Company, Event etc. are some of the entities.

Entity set - An entity set is a set of entities of the same type that share the same properties.
E.g. Set of all departments, students etc.

Relationship - The connection among two or more entity set is called relationship.
In other words, a relationship is an association among several entities.

E.g. [Ram] study in [BCE department].
↑ entity, ↑ relationship, ↑ entity

[Admin] manages the [Campus].

Attributes - Attributes are descriptive property that each member of the entity contains.

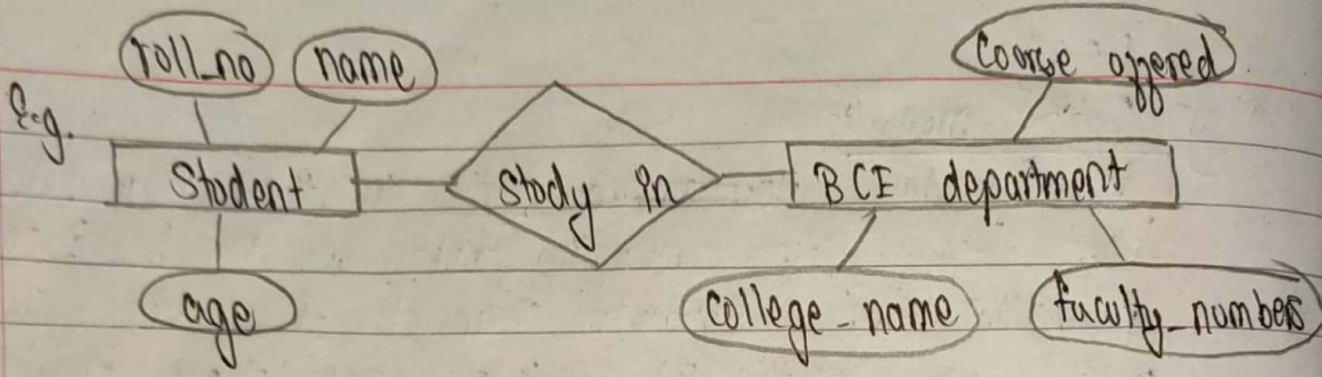


Fig: ER diagram

: Entity

: Attributes

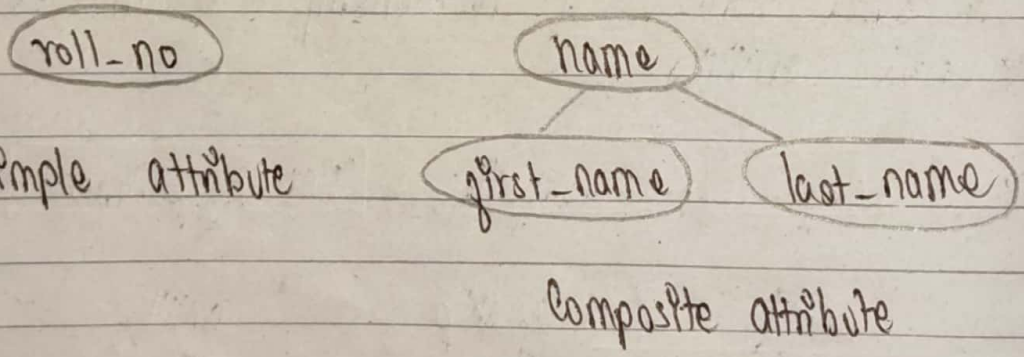
: Relationship

There are different types of attributes.

i) Simple and Composite attributes :-

The attribute that cannot be broken down is called simple attribute whereas the attribute that can be broken down is called composite attribute.

E.g.



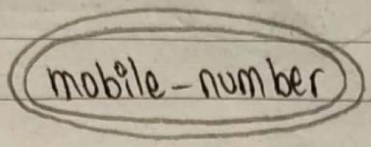
simple attribute

Composite attribute

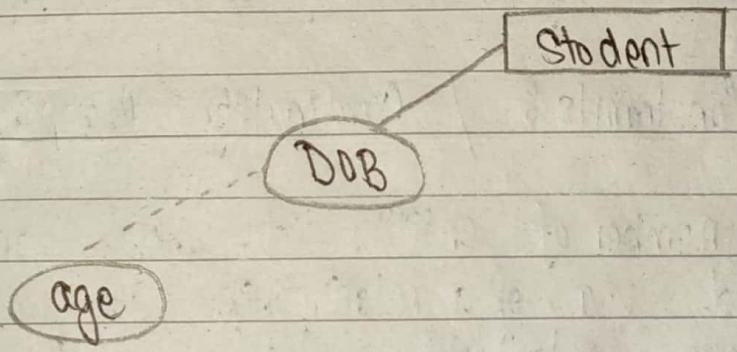
ii) Single valued and multiple valued attributes :-

In single valued attribute, it consists of only a single value whereas in case of multivalued attribute, they can have more than one value for an attribute.

E.g. mobile-number Attribute.



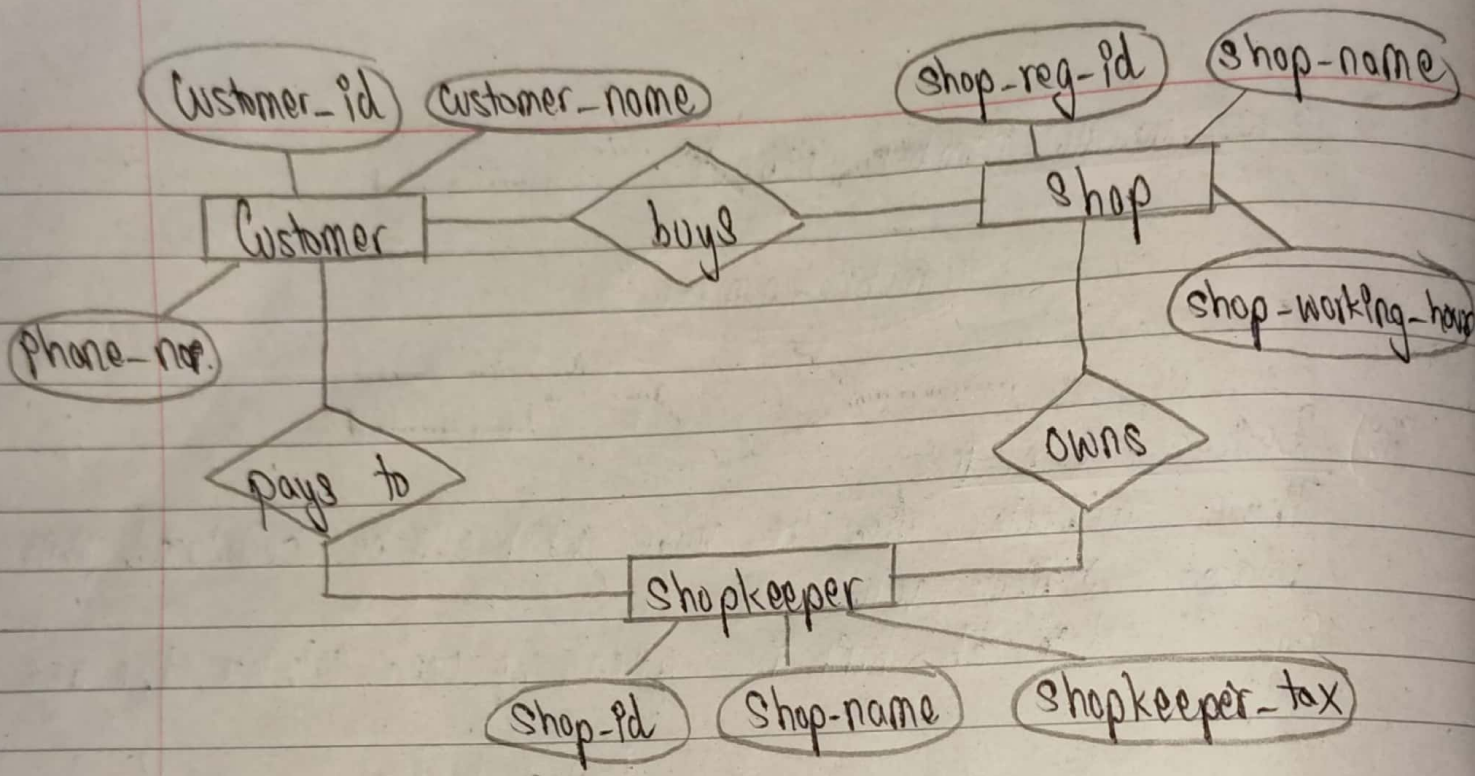
iii) Derived attribute :-
These attributes are the value which can be calculated from related attribute values.
E.g. If date of birth is given, we can calculate the age attribute.



iv) Descriptive attribute :-
A relationship may also have attribute which is called descriptive attribute.

Q. Draw an ER diagram consisting of three entities sets customer, shop and shopkeeper.
Customer buys from shop.
Shopkeeper owns shop.
Customer pays to shopkeeper.

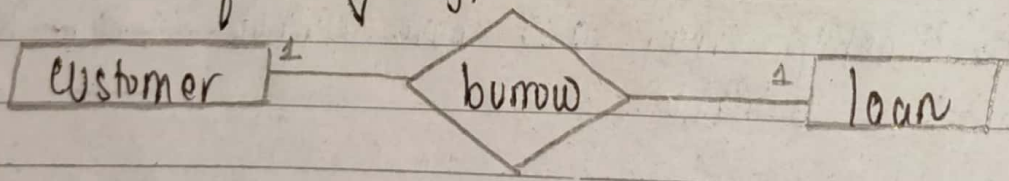
Entity	Relationship
Customer	buys
Shop	owns
Shopkeeper	pays



Cardinality Constraints :- / Cardinality Mapping :-

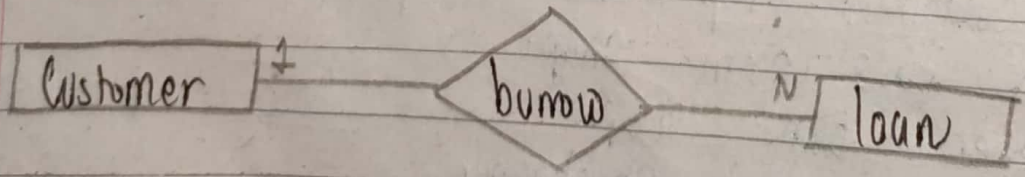
- Express the number of entities to which another entity can be associated via of a relationship set.
- For the binary relationship, the mapping cardinality must be of the following types.

1)



Ex: One to One

2)



Ex: One to many

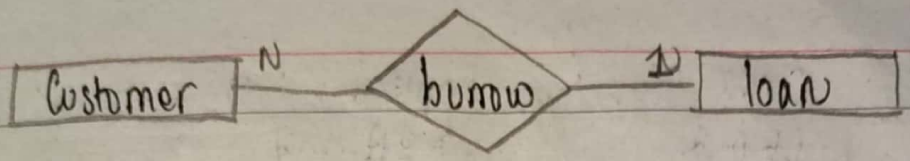
3) 

Fig: Many to ~~Many~~ one

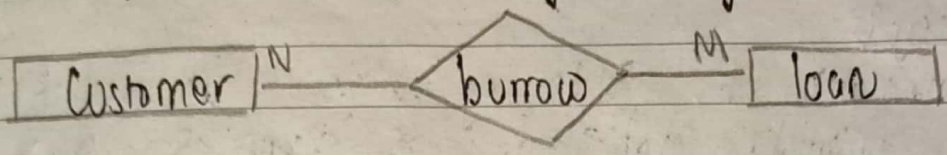
4) 

Fig: Many to Many

V. Imp

Keys in DBMS:-

Keys are used to find the unique row in a relation table. There are different types of keys in DBMS.

1. Super key
2. Candidate key
3. Primary key
4. Alternate key
5. Foreign key.

Table name: Student

S_roll	S_name	S_faculty	S_State
1	Abc	BCV	1
2	Cde	BCE	2
3	Fgh	BCV	1
4	Hij	BEX	2

Table name: Student_course

S_roll	Course_code	Course_name
1	CV01	Structure
2	CE01	DBMS

relation (or table)

3	CV02	Applied
4	CE02	DSA

1) **Super key :-**
The combination of fields by which the row of the data can be uniquely identified is known as super key.
Eg. {s-roll}, {s-roll, s-name}, {s-roll, s-name, s-faculty} & so on.

2) **Candidate key :-**
The minimal set of attribute which can uniquely identified or tuple (or rows) is known as candidate key.
E.g. s-roll is a candidate key.

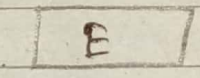
3) **Primary Key :-**
There can be more than one candidate key in a relation out of which one can be chosen as primary key.
The choice is made by the database designer.
Eg. s-roll is the primary key.

4) **Alternate key :-**
The candidate key other than the primary key is called alternate key.
E.g. If we add s-phonenumber into the table student, the s-roll and s-phone are both candidate key and one may become primary key and the other alternate key.

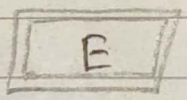
5) Foreign key :-
If an attribute of a table takes the value which are present as values of some other attribute, then it will be called to the attribute to which it refers.
E.g. S-roll in student course table is a foreign key to S-roll in the student table.

Strong & ~~weak~~ weak entity set :-
An entity set which do not have sufficient attribute to form a primary key is called weak entity set, where as an entity set which has primary key is called strong entity set.

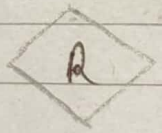
Symbols in ERS :-



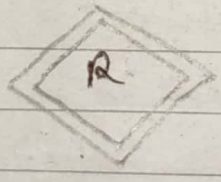
Entity set



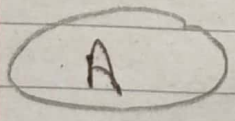
weak entity set



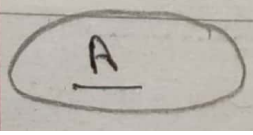
Relationship set



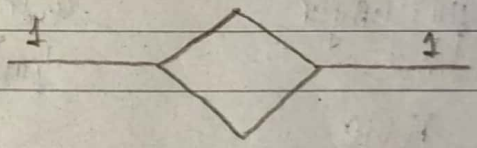
Identifying relationship set for weak entity set.



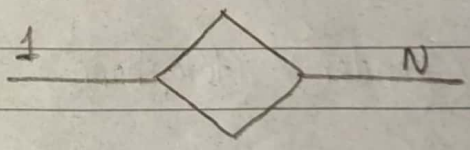
Attribute



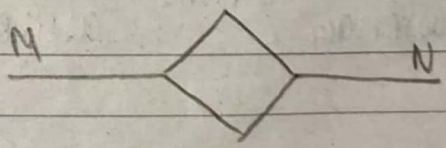
Primary key



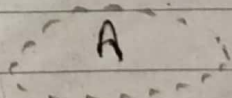
One to one



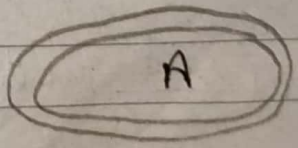
One to many



many to many



Derived attribute



Multivalued attribute.

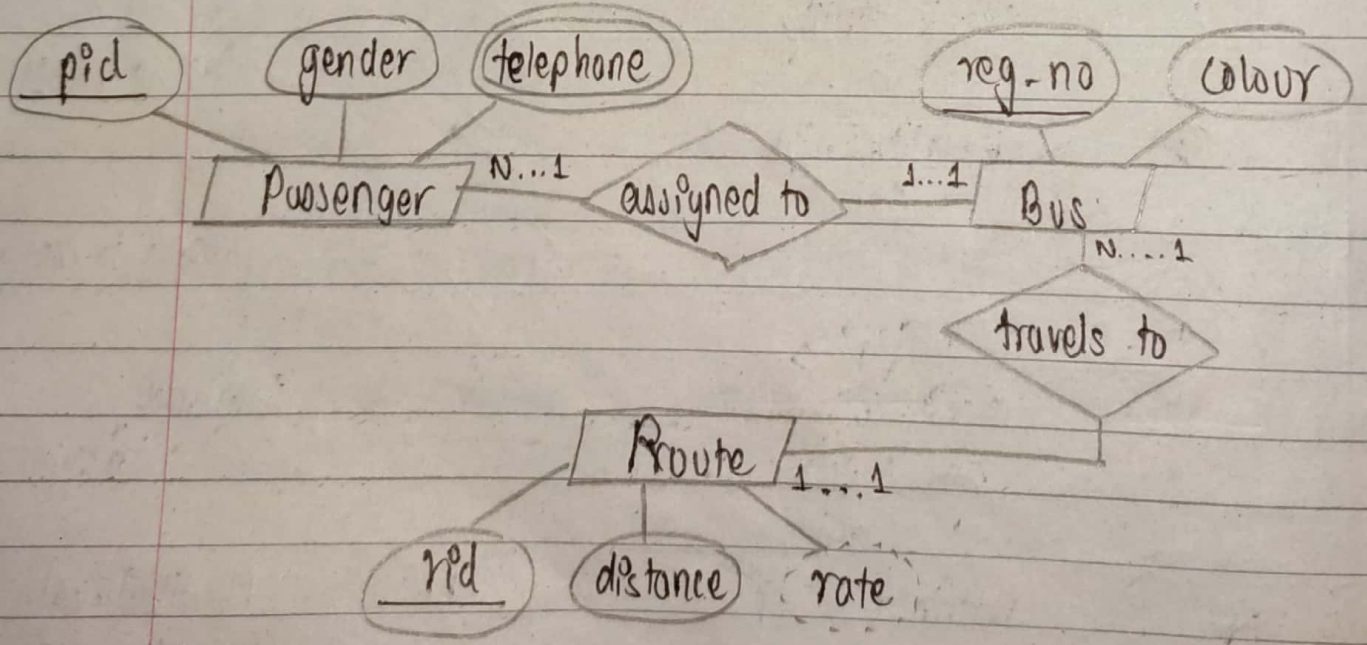
Steps for ER → Cardinality mapping.

→ finding entities
→ " relationship
→ " attributes (derived / multivalued / simple)

Q>. Consider a bus ticketing system that records information above the passenger, bus and route. Passenger is assigned to a bus and bus travels to route. A bus is assigned to many passengers and a passenger can be assigned into only one bus. Many buses travel to the same route but a bus can travel only in one route. The attribute of passenger are pid (unique), gender & telephone (multivalued).
Similarly, bus contains reg_no (unique) & colour as attribute. Route contains rid (unique), distance & rate (based on distance) as attribute. (derived attribute)
Draw the ER digram for the given scenario.

Ans⇒

Entities	Relationship
passenger	assigned to
bus	travels to
route	

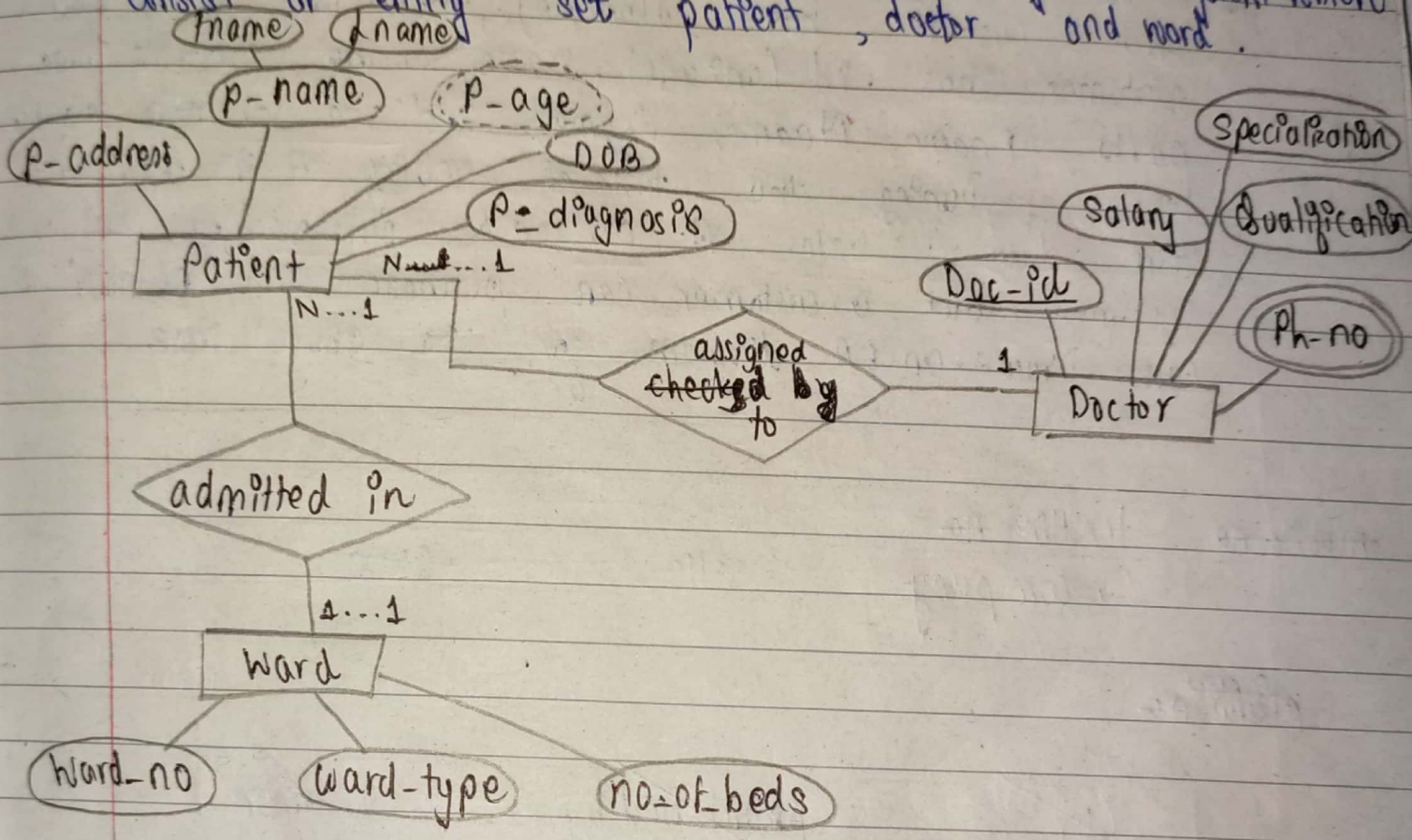


try to make diff attributes types

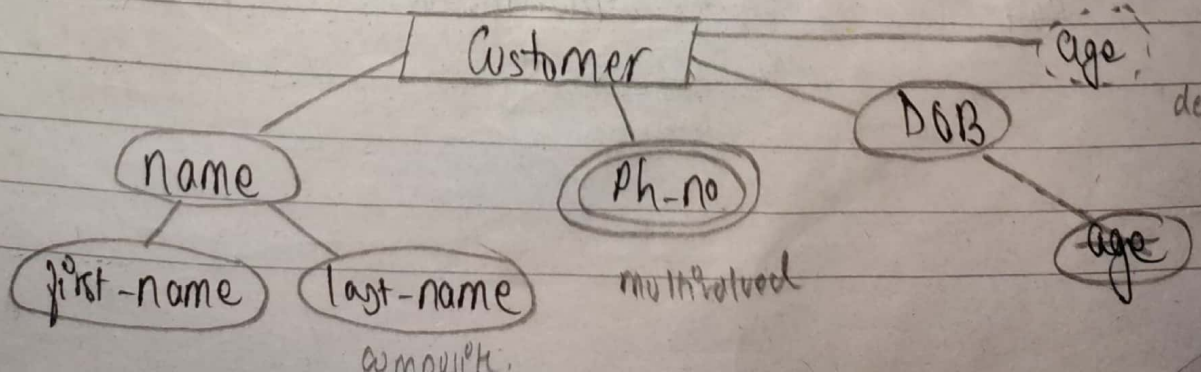
Entities
patient
Doctor
ward

Relationship.
~~checked by~~ admitted in
~~checks~~ assigned to

Q7. Draw an ER diagram of Hospital Management System which consist of entity set patient, doctor and ward.

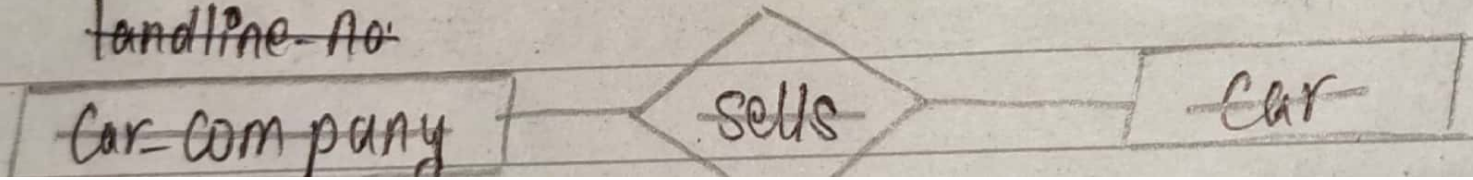


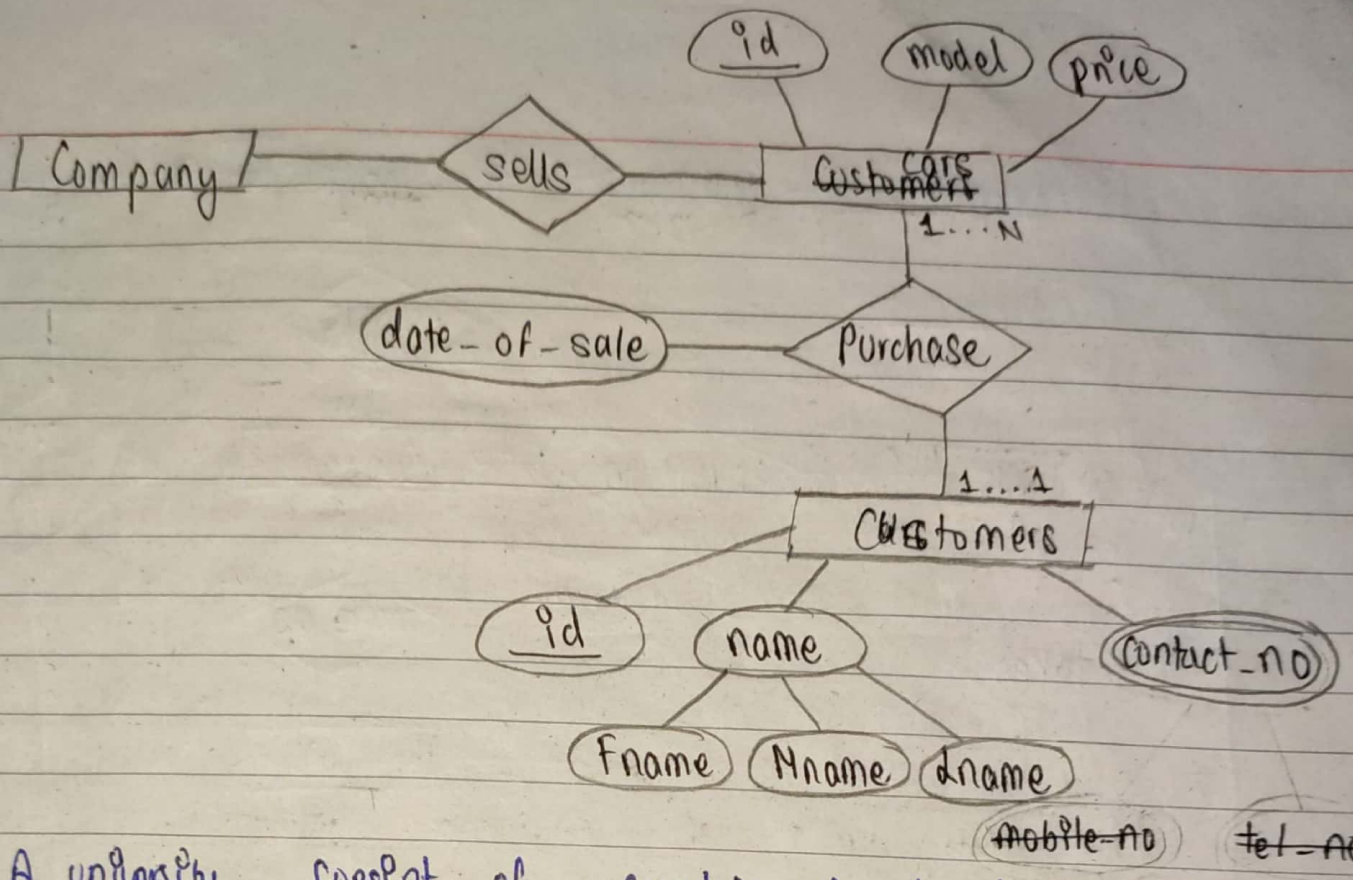
Q8. Give an example of composite, multivalued and derived attributes using ER diagram. Assume an entity for the case.



Q7. Consider a car company that sells car to its customers. Each customer has id(unique), model and price. Each customer has id (unique), name (that contains three parts Fname, Mname, Lname) and one or more telephone (multivalued) no. During the time of selling it is required to store date of sale (attribute of purchase). A car can be purchased by only one customer but a customer can purchase any number of cars. Draw an ER diagram for the above case.

~~mobile-no~~ ~~landline-no~~

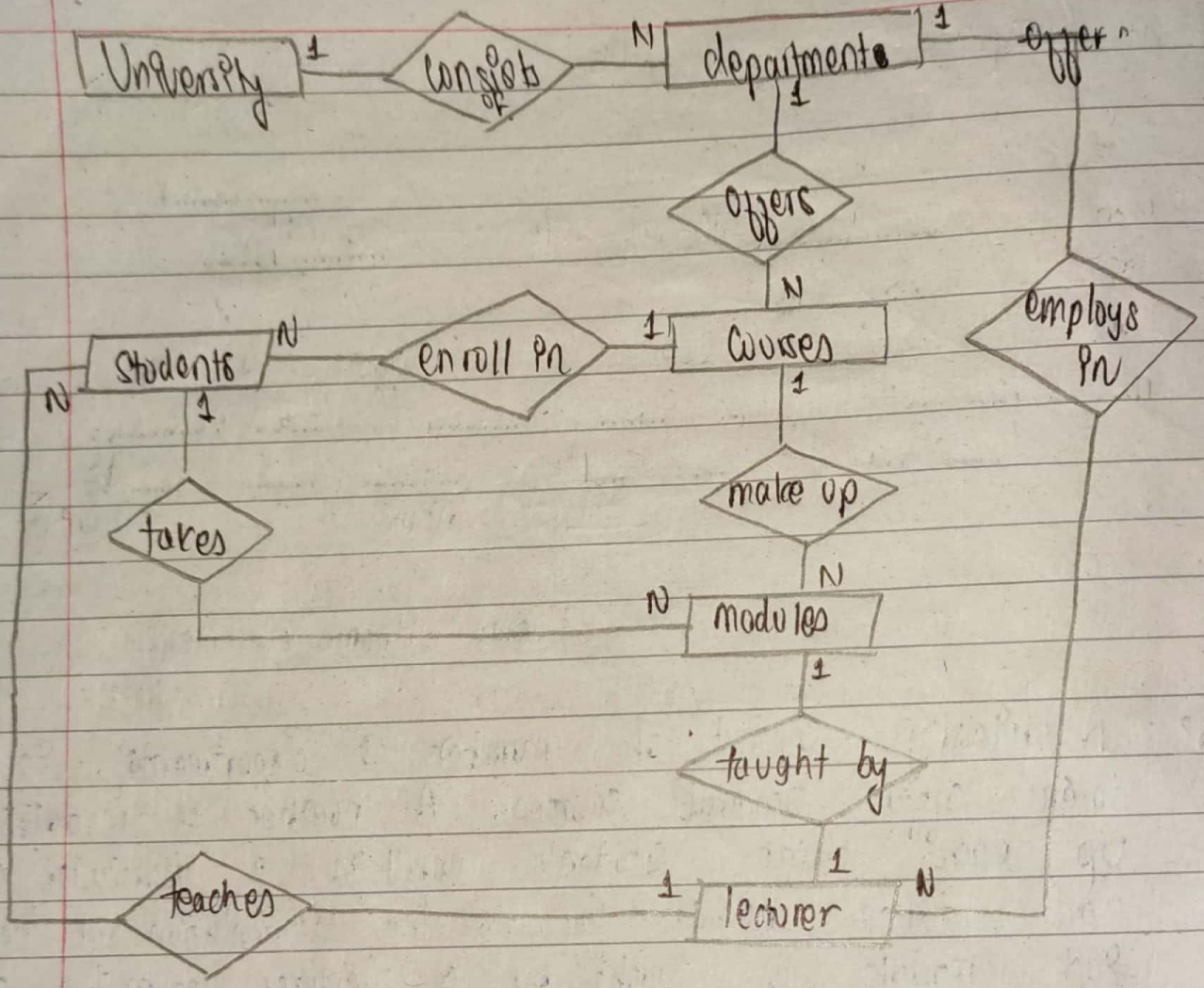




Q7. A university consist of number of departments. Each department offers several courses. A number of modules make up each course. Students enroll in a particular course and takes modules towards the completion of the course. Each module is taught by a lecturer from the appropriate department and each lecturer teaches a group of student. Draw an ER diagram for the given scenario.

Entities	Relationship
University	consists of
departments	offers
Courses	
modules	make up
Student	enroll
lecturer	teach

If attribute not given, no need to add.
→ cardinality mapping do if needed.


University
1
consists of
N
departments
1
offer
1
offers
N
employs PN
N
Students
N
enroll PN
1
Courses
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N
1
takes
make up
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N
modules
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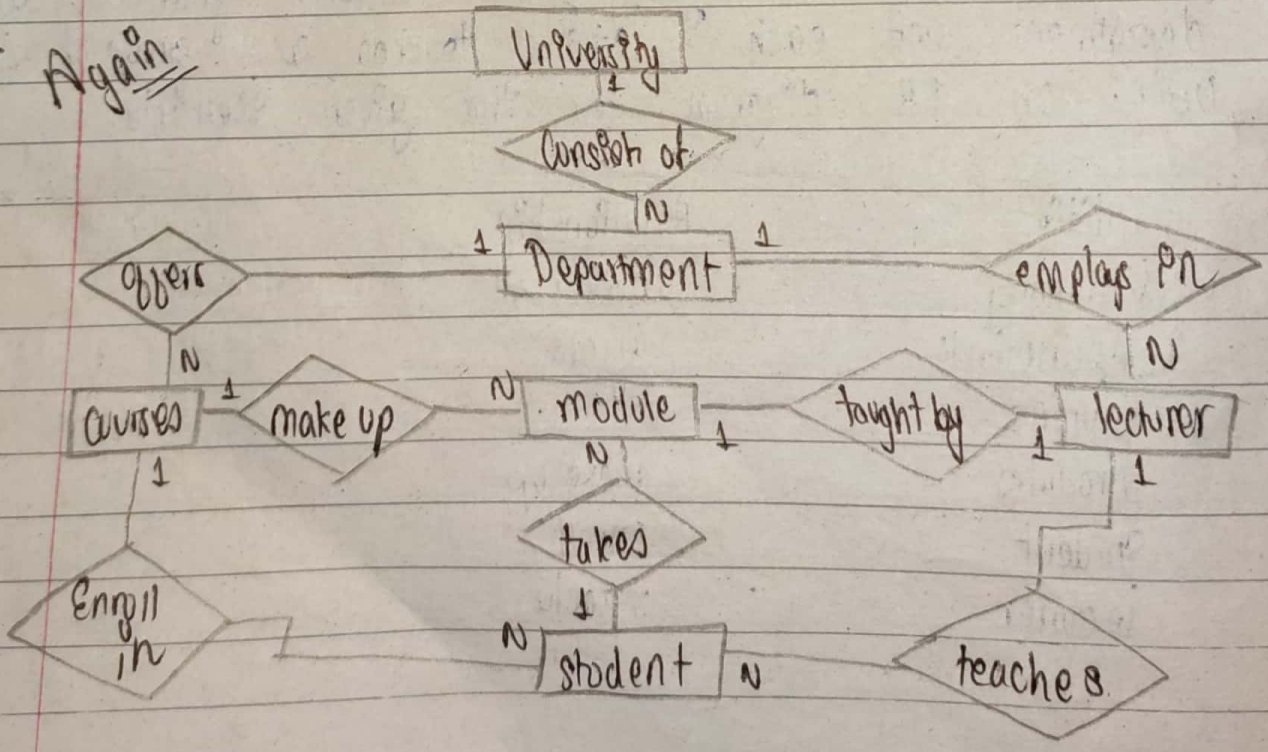
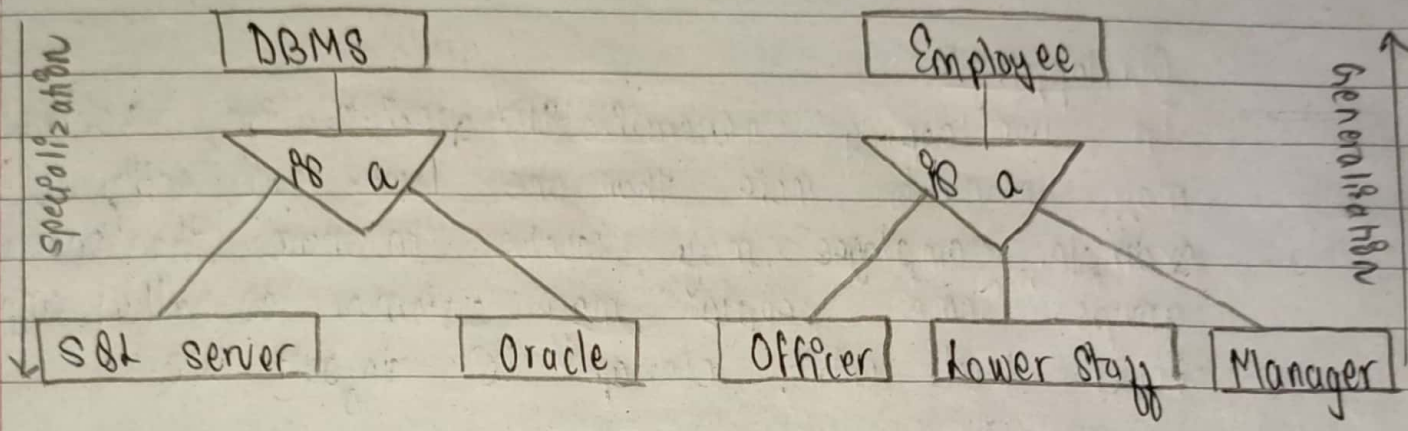
taught by
1
teaches
1
lecturer
N

Again.


University
1
Consists of
N
offers
1
Department
1
employs PN
N
N
Courses
1
make up
N
module
1
taught by
1
lecturer
1
N
1
takes
1
Enroll in
N
student
N
teaches

Practice ER
-> Hotel " "
-> College " "
-> Library " "

Generalization & Specialization :-



Generalization is the result of taking the union of two or more entity sets to produce a higher level entity set. It is bottom of design process.
Specialization is the result of taking subsets of high level entity sets to form low level entity sets. It is top down design process.

HW
Q>. What do you mean by disjoint and overlapping in generalization & specialization? Explain aggregation in context of database

Ans:- To indicate the constraint on whether or not entities may belong to more than one lower-level entity set within a single generalization, lower level entity set may be disjoint or overlapping.

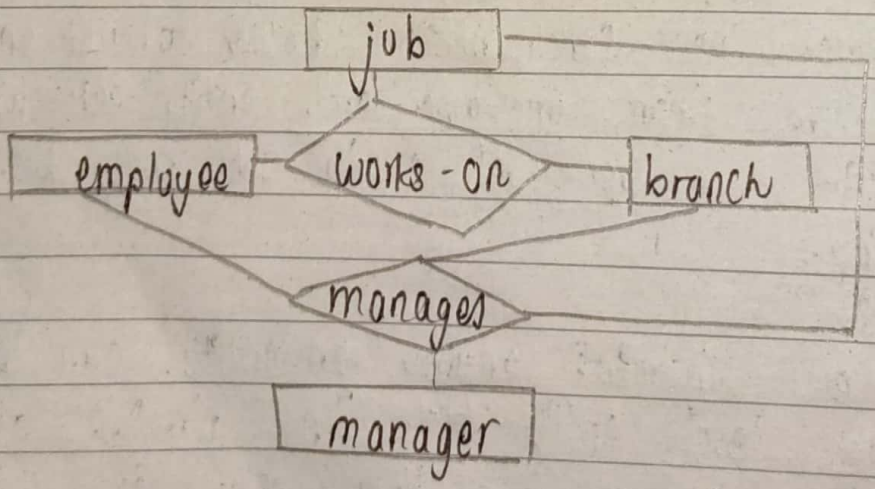
Disjoint:-
Disjointness constraints enforce an entity can belong to only one lower level entity set. In previous account example, entities in account can either belong to saving_account or checking_account, can not both. In E-R diagram, it can

be express by writing disjoint next to the ISA triangle.

Overlapping :-
In overlapping generalization/specialization, same entity may belong to more than one lower level entity set. For example, employee may involve in more than one work-groups. Some people may customer as well as employee. Lower level entity overlap is default case.

⇒ Aggregation is an abstraction in which relationship sets along with their associated entity sets are treated as higher-level entity sets, and can participate in relationships.

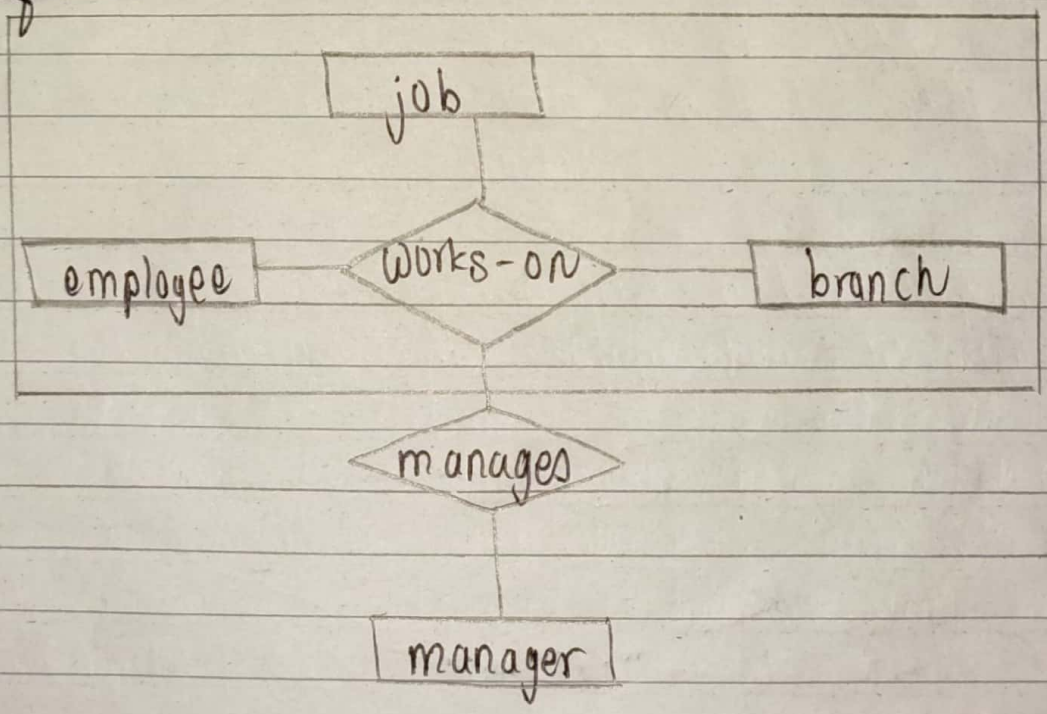
E-R model cannot express relationship among relationship. To illustrate this, let us consider quaternary relationship manages among employee, branch, job and manager. Its main job is to record managers who manages particular job/task perform by particular employee at particular branch.



E-R diagram with redundant relationships.

The quaternary relationship is required since binary relationship between manager and employee cannot represent required information. This E-R diagram is able to represent the required information but information are redundant since every employee, branch and job exist both relationship set "work-on" and "manages". Here aggregation is better to represent such information.

In our example, aggregation treats relationship set work-on (including entity set employee, branch and job) as entity set. So now we can create binary relationship set "manages" between work-on and manager. This removes redundant information.



E-R Diagram with aggregation