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MODULE 1

Principles of DBMS

Data → 3 types. They are:

(i) Structured Data

Any data that can be represented using relational model (Table format). It is easy to manipulate.

eg: Sql.

(ii) Semi-Structured Data

Any data that has an organisational structure but is not in tabular form

eg: XML, JSON, NOSQL

(iii) Unstructured Data

It is difficult to manage. It is of 2 types:

(a) Machine generated → Satellite images

(b) Human generated → Social media files

eg: Text files

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Database

Collection of inter-related data

Properties of Database

(i) Every database represents a MiniWorld or Universe of Discourse (UOD) & any change in the ~~database~~ MiniWorld may reflect changes in the ~~MiniWorld~~ database

(ii) Database is the logically coherent collection of some inter-related data

(iii) Database is built, populated for a specific purpose

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(iv) Database has varying size & complexity

Database Management System (DBMS)

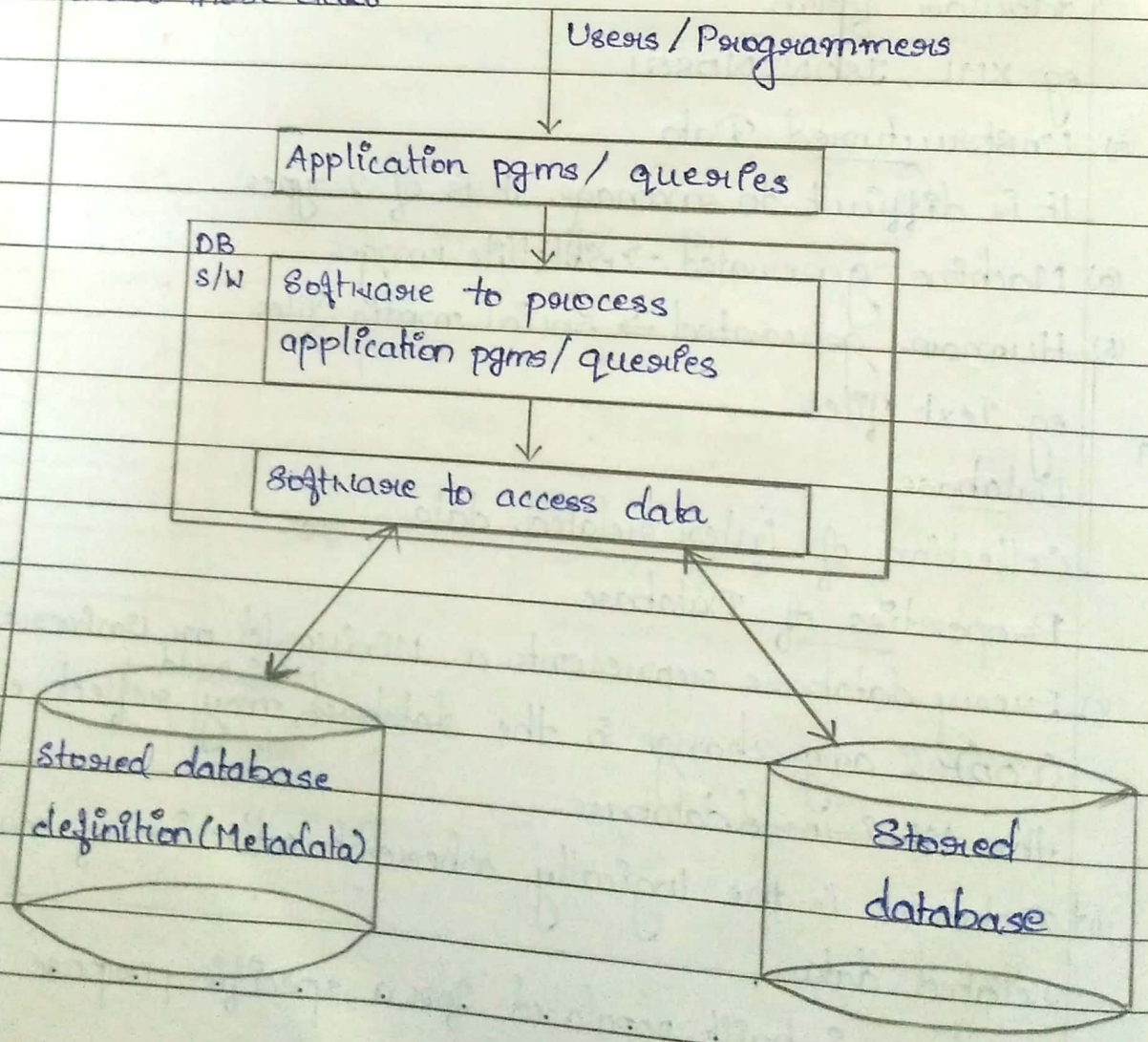
It is a general purpose software system that facilitates the process of defining, constructing, manipulating the database.

(i) Defining → Defining the structure, data types & constraints

(ii) Organizing / Constructing → Storing the database.

(iii) Manipulating → Insertion, deletion, updation & querying the database (searching)

It is a collection of inter-related data & set of programs to access those data.



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The fig. represents a simplified database environment
The definitions of the database are stored in the system catalog / data dictionary
The original data is stored in the stored database

Train Reservation System

Passenger Name	Train No.	Date of Journey	Coach	Seat No.
Ramesh	12711	10-11-2018	B2	55
John	12315	10-12-2018	C3	21
Babu	12255	10-01-2019	B6	46

Airline Reservation System

Passenger Name	Flight No.	Date of Journey	Seat No.
George	DL31	15-12-2010	24C
Vijayan	EVL 025	10-01-2017	F24
Yomi	GHE 531	28-07-2018	27A

Bus Reservation System

Passenger Name	Bus No.	Date of Journey	Seat No.
Suseela	KL 7L 1234	16-11-2015	12A
Mathew	KL 8B 9320	20-05-2017	06B

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Hospital Management System

Patient Name	Doctor Name	Date of Visit	Card No.
Abhijith	Ramesh	28-12-2016	AF123
Abin	Vineeth	15-01-2017	IG483
Ajesh	Ram	06-08-2018	AE484

Hotel Management System

Occupant Name	Room No.	Check-in Date	Check-out Date
Rajesh	5E	20-10-2016	26-10-2016
Nisha	3B	15-08-2017	17-08-2017

College Library Management System

Book No.	Student Card No.	Date of Pick up	Date of Return
19280	804218	20-11-2017	30-11-2017
24356	795422	10-08-2015	20-08-2015
31259	815624	05-01-2018	15-01-2018

Police Station Record System

Case No.	Prisoner ID	Prisoner Name	Date of FIR Registration
318/2014	17483	George	20-12-2014

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Social Media Management System

User ID	Password	Number	Location
karish32	1234*	9496742810	India
sus12mit	Abc@G	6282487654	Canada
john748	74Acd	7920815466	London

Airline Reservation System Database

AIRPORT

Passenger Name	Airline Name	Date of Journey	Source	Destination
Abhijith	Emirates	10/11/2018	Kochi	Dubai
Della	Malindo	5/9/2018	Kochi	Malaysia
Gopika	Indigo	21/8/2018	Kochi	Hyderabad
Hari	Jet Airways	15/1/2019	Kochi	Mumbai
Jerry	Spicejet	30/10/2018	Kochi	Delhi
Kaumudy	Singapore	6/5/2018	Kochi	Singapore
Megha	Lufthansa	11/4/2018	Kochi	London

EMIRATES

Flight No.	Passenger Name	Seat No.	Date
EK227	Abhijith	24C	10/11/2018

MALINDO

Flight No.	Passenger Name	Seat No.	Date
OD1608X	Della	20A	5/9/2018

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INDIGO

Flight No	Passenger Name	Seat No.	Date
6E 151	Gopika	12A	21/8/2018

JET AIRWAYS

Flight No.	Passenger Name	Seat No.	Date
X140CT	Hasif	5B	15/1/2019

SPICEJET

Flight No.	Passenger Name	Seat No.	Date
SG184	Jeeary	10C	30/10/2018

SINGAPORE AIRLINES

Flight No.	Passenger Name	Seat No.	Date
SQ318	Kaumudy	14B	6/5/2018

LUFTHANSA

Flight No.	Passenger Name	Seat No.	Date
LH 582	Megha	36F	11/4/2018

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Superkey

An attribute / set of attributes is used to identify a tuple in a relation

Candidate Key

A minimal superkey

Primary Key

1 of the candidate keys selected by a database administrator to identify a tuple in the relation.

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Keys of Airline Reservation System Database

(i) AIRPORT

Super Key: { Passenger Name, Airline Name, Destination }
Candidate Key: { Passenger Name, Airline Name }

(ii) EMIRATES

Super Key: { Flight No, Seat No, Passenger Name }
Candidate Key: { Seat No, Flight No }

(iii) MALINDO

Super Key: { Flight No, Passenger Name, Seat No }
Candidate Key: { Seat No, Flight No }

(iv) INDIGO

Super Key: { Flight No, Passenger Name, Seat No }
Candidate Key: { Seat No, Flight No }

(v) JET AIRWAYS

Super Key: { Flight No, Passenger Name, Seat No }
Candidate Key: { Seat No, Flight No }

(vi) SPICEJET

Super Key: { Flight No, Passenger Name, Seat No }
Candidate Key: { Seat No, Flight No }

(vii) SINGAPORE AIRLINES

Super Key: { Flight No, Passenger Name, Seat No }
Candidate Key: { Seat No, Flight No }

(viii) LUFTHANSA

Super Key: { Flight No, Passenger Name, Seat No }
Candidate Key: { Seat No, Flight No }

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Characteristics of Database Approach

(i) Self describing nature of data
(ii) Insulation btw programs, data & data independence
(iii) Multiple views of data
(iv) Sharing of data & multiuser transaction processing

Relation Name	No. of attributes
Book	6
Customer	4
Author	3
Publisher	3

Column Name	Data type	Belongs to relation
Bid	varchar(10)	Book
Bname	varchar(5)	Book
⋮	⋮	⋮
cusname	varchar(5)	Cusname
⋮	⋮	⋮
Pid	varchar(3)	Publisher

4/2/19

- Self Describing Nature of Data
  → Database stores not only stored data but also the description of definition of database
- Insulation btw Programs, Data & Data Independence
  → Program-data independence (Relational model)
  → Program-operation independence
  → Operation → Signature (interface)
  → Implementation
  → If we change the interface, we need not change the implementation.
  → The programs that allow program-data independence & program-operation independence is called data abstraction

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- Multiple Views of Data

→ Database allows different types of views

→ These views can be derived from & are part of the database

- Sharing of Data & Multiuser Transaction Processing

ACID

A	B
read (A)	
A = A - 5000	
	read (B)
	B = B + 5000
write (A)	
	write (B)

A → Atomicity
C → Consistency
I → Isolation
D → Durability

→ Multiple transactions can occur at the same time

→ Atomicity → Either all operat^ns in a transact^n must be completed or none of them should be completed.

→ Consistency → Every database transact^n should proceed from 1 consistent state to another.

→ Isolation → Every transact^n should proceed in an isolating manner even if multiple transact^ns are executing concurrently.

→ Durability → Database should persist even in case of network failure or natural disasters.

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Schema ~~(Extension)~~ (Intention)

Book (ISBN, Bname, Authorname, Pid)

Author (Aid, Authormame)

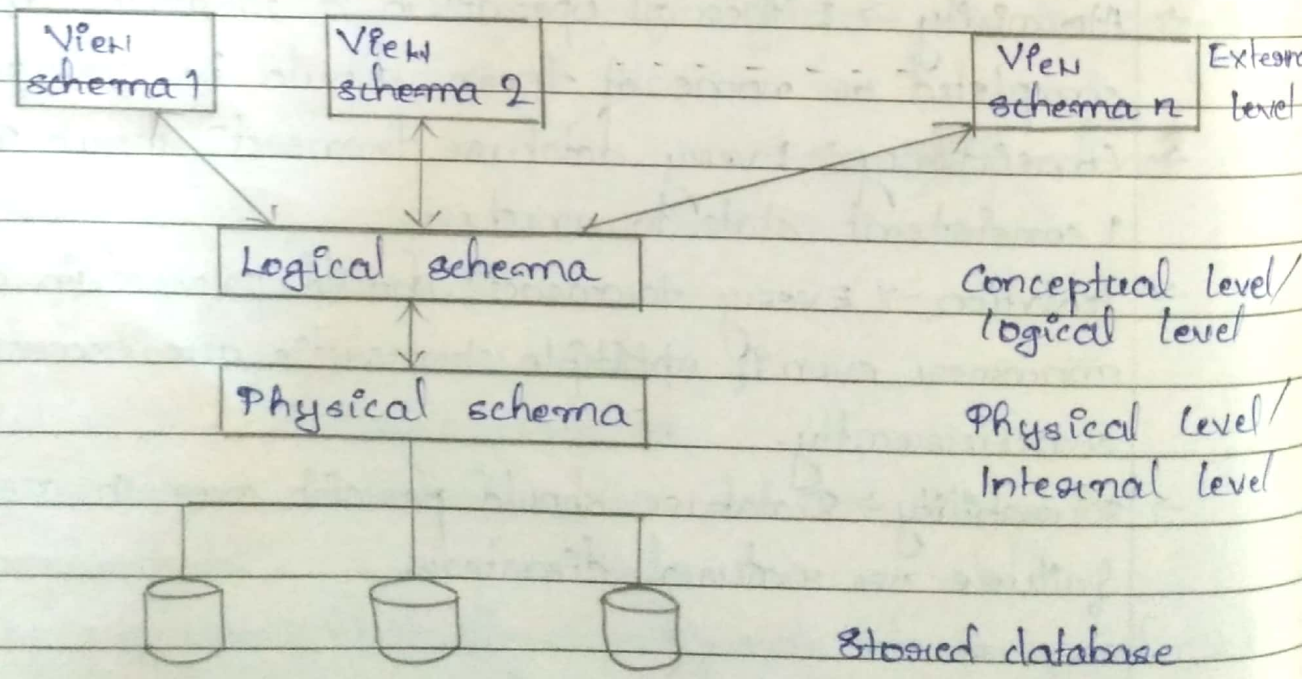
Publisher (Pid, Pname, Plocation)

Instance ~~(Extension)~~ (Extension)

ISBN	Bname	Author name	Publisher
976-01	DCS	Stanley	Pearson
973-32	Graph Theory	Demming	MGRH

- Overall design of the database is called database schema
- Snapshot of the database is called instance. or the data stored in the database at a particular time is called database instance
- Instance is also called state of the database

3 Schema Architecture & Data Independence



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- Logical Level → Overall database design
- External Level → Part of logical level
- Physical Level → Low level data, it's type etc
- Schema designed at physical level → Physical schema
- " " logical " → Logical "
- " " external " → External "
- Data Independence

→ Capacity of each level to change it's schema without affecting the next higher level

→ Physical & logical data independence

→ Physical data independence → Capacity of physical level to change it's schema without affecting the logical level

→ Logical data independence → Capacity of logical level to change it's schema without affecting the sub/external level

Data Model

Data Model

- Low-level (Physical)
- Representational (Implementational)
  - → Network
  - → Hierarchical
  - → Relational
- Conceptual (High Level)
  - → ER model
  - → Object relational

ER Model → Entity-Relationship Model

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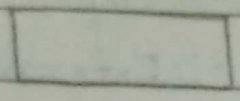
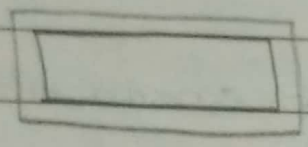
- Data model is the conceptual tool for describing data, its semantics & constraints.
- Physical data model represents low level features

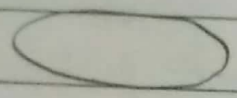
ER Model



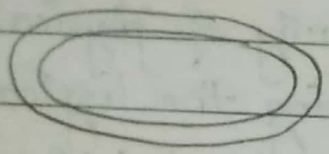
Strong entity



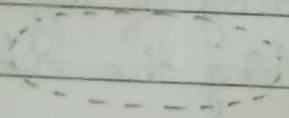
Weak entity



Attribute

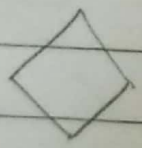


Multivalued attribute

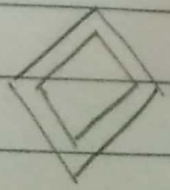


Derived attribute

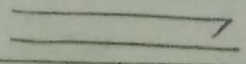
Connecting entities to attributes/ entities to relationships



Relationship



Identifying relationship



Total participation

- Everything is represented as an entity & its relationship
- Entity is anything that has existence in real world.

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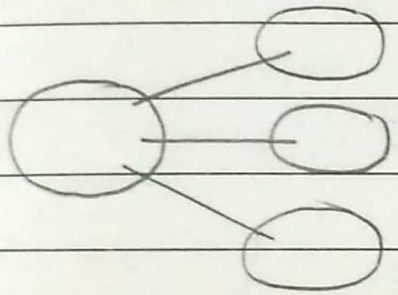
- Entity has some attributes

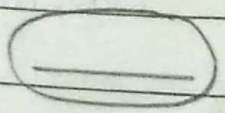
Student entity type	Simple or composite
entity set	Single or multivalued
value set	
	Stored or derived
	null

- Single / multivalued → Entity which has more than 1 value



Composite

- Stored / derived → Entity which can be derived from another entity that is stored
→ eg. Age from date of birth
- Null → Entity that can take the null value
→ eg: Phone no., email id
- Strong entity → Entity which has it's own primary key
- Weak entity → Entity which does not have it's own primary key



Key attribute (Primary key)

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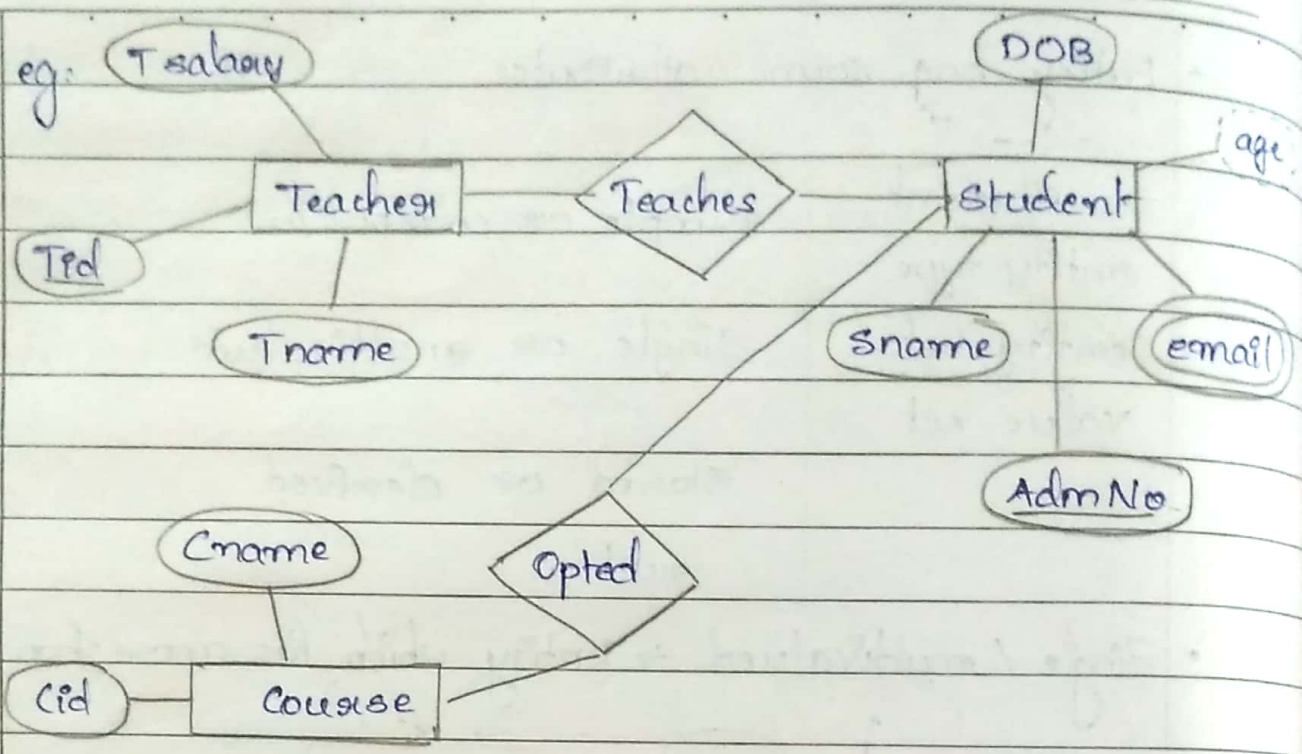
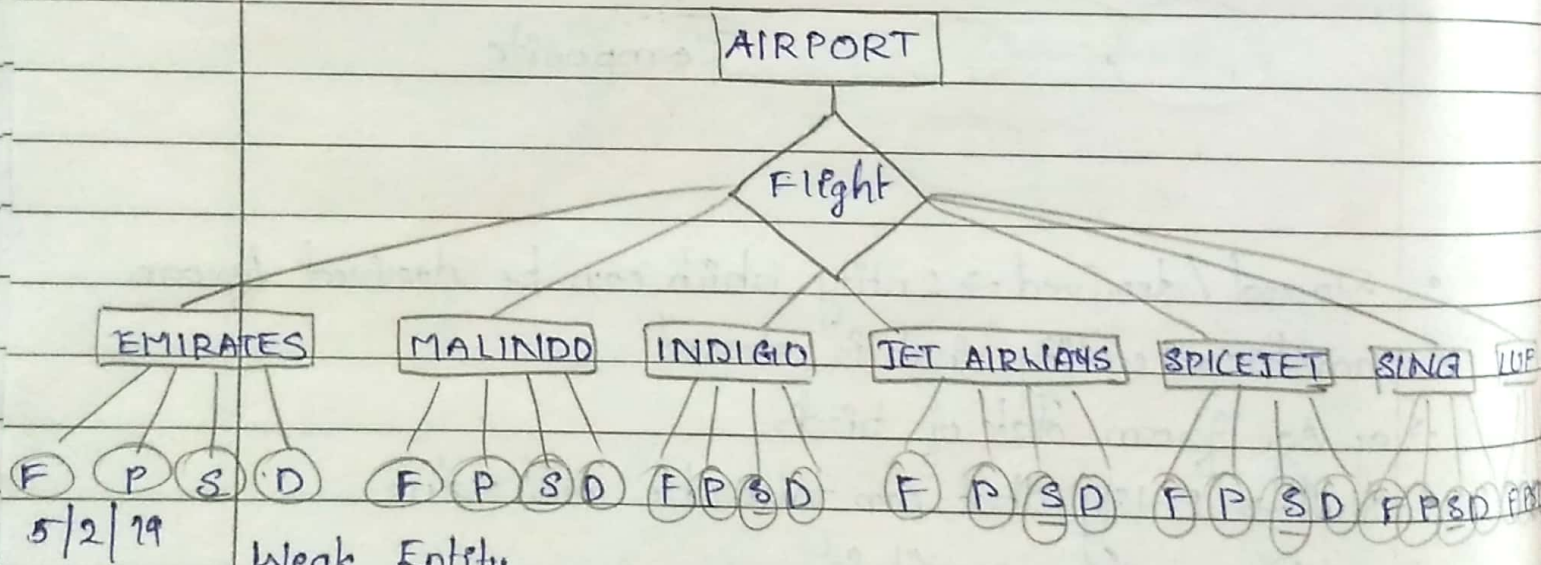
eg:





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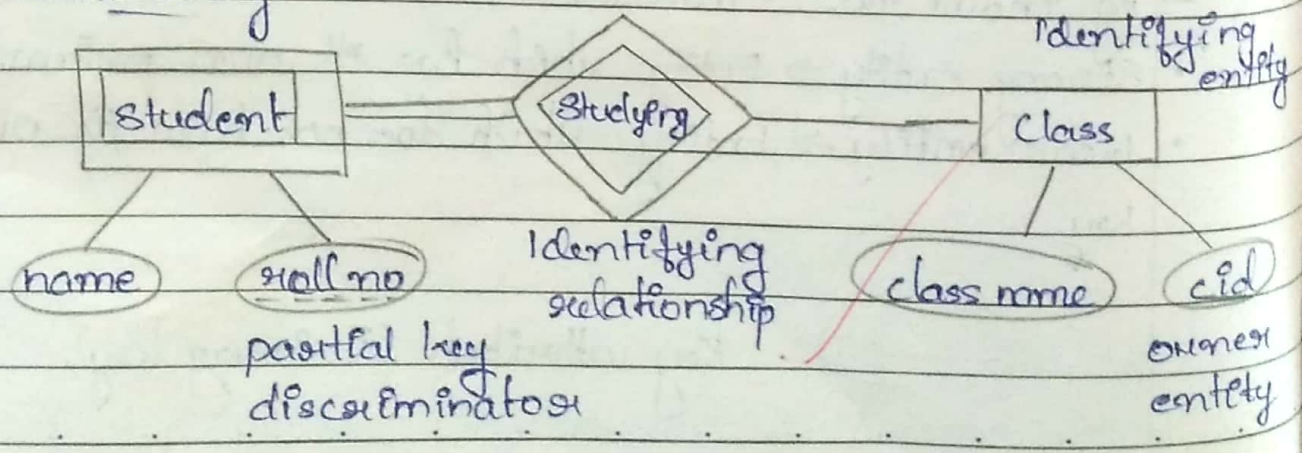
Weak Entity



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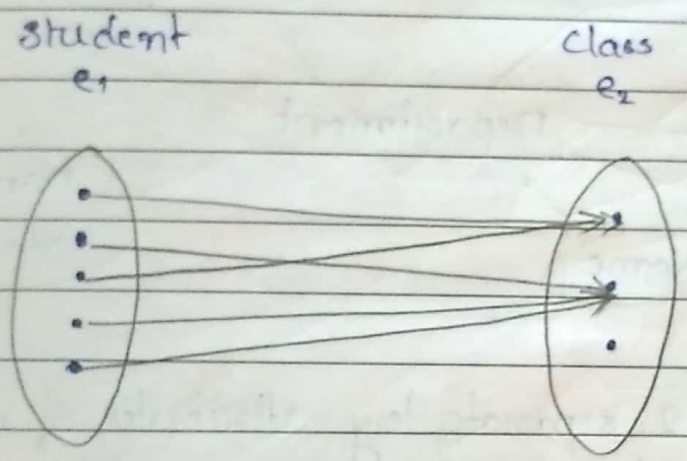
Key attribute (Weak entity)

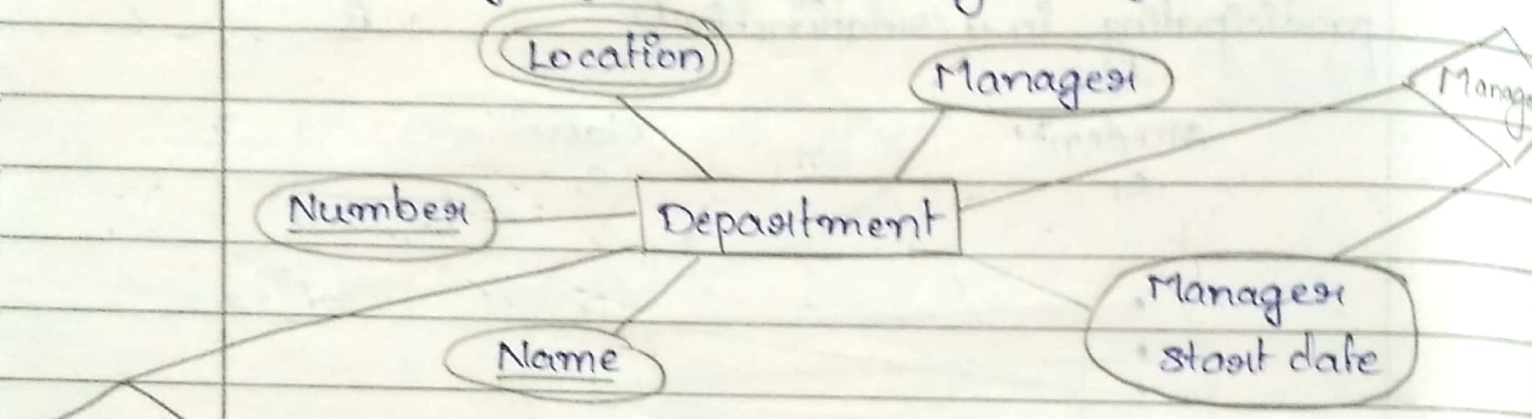
- Identifying relationships are denoted by double-sided diamond box
- Total participation → Every entity in an entity set is participating in a relationship



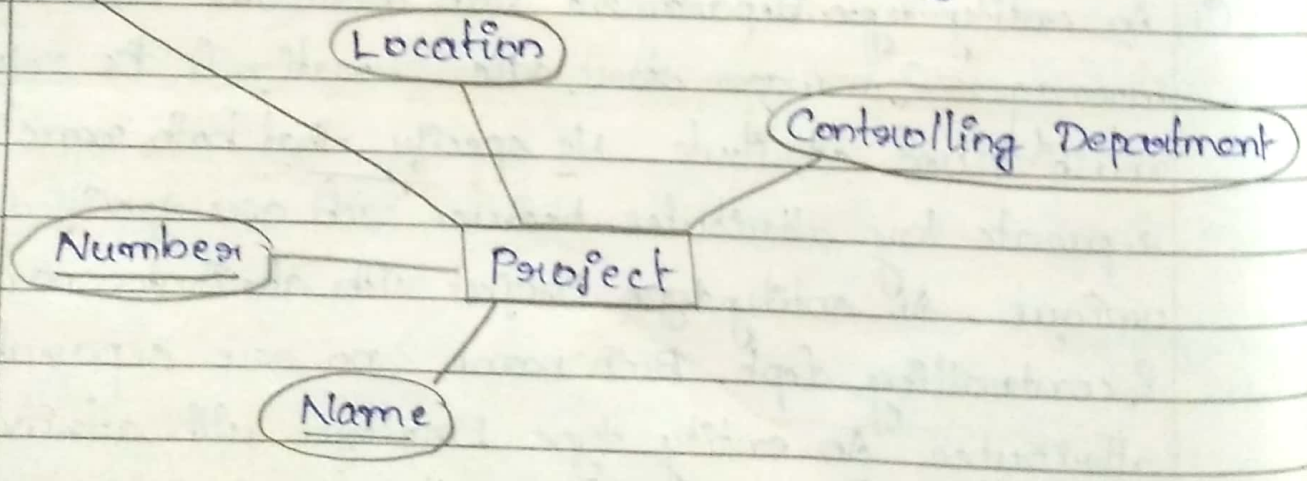
① An entity type Department with attributes name, no., locat^n, manager & manager start date. Location is the only multivalued attribute. We specify that both name & no. are separate key attributes because each are specified to be unique. An entity type Project with attributes name, no, locat^n & controlling dept. Both name & no. are separate key attributes. An entity type Employee with attributes name, ssn, sex, address, salary, birth date, dept & supervisor. Both name & address may be composite attribute. An entity type Dependent with attributes employee, dependent name, sex, birthdate & relationship to the employee. Employee can

assigned for an employee who is working on the proje
In Employee entity ssn is the key attribute

ans Department has 2 separate key attributes of which both ca
be primary keys. So it is strong entity



Project has 2 separate key attributes of which both can
be primary keys. So it is strong entity



Employee has 1 key attribute which is a primary key
It is strong entity

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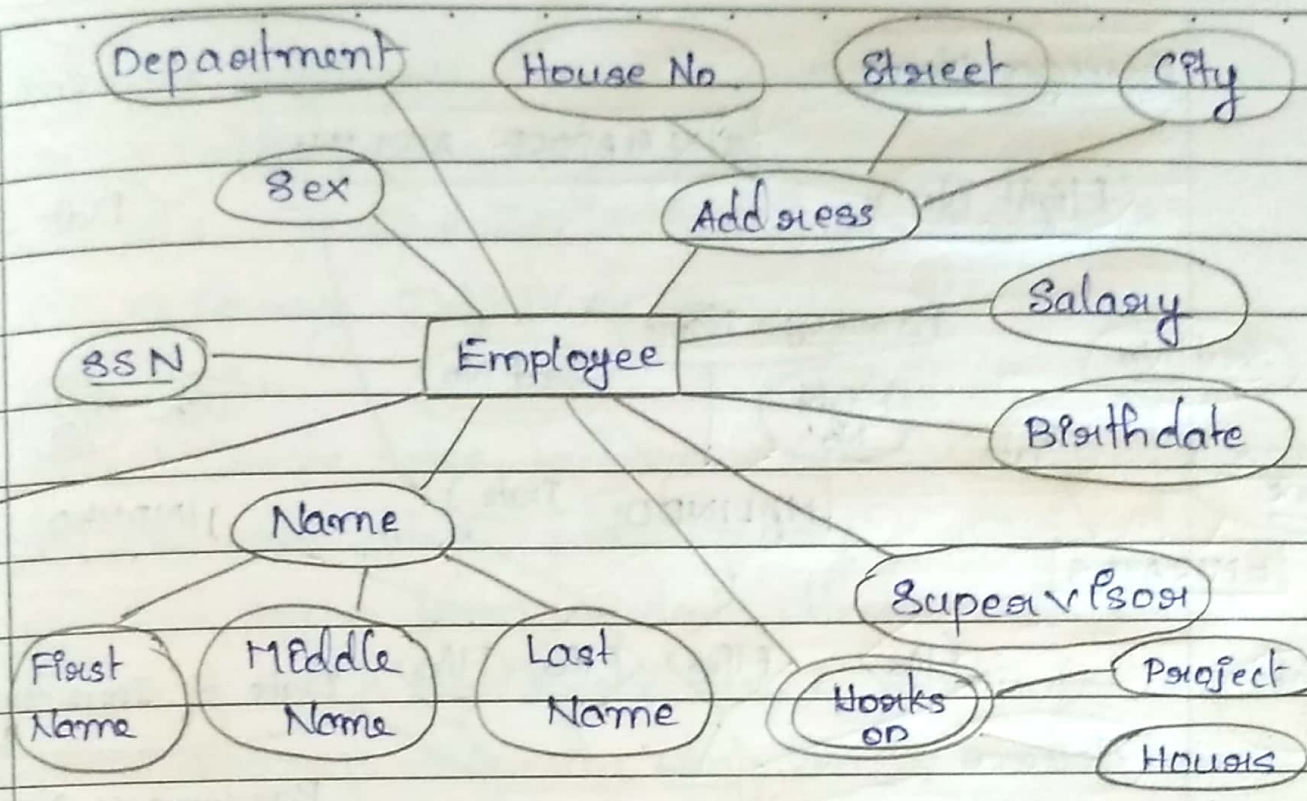
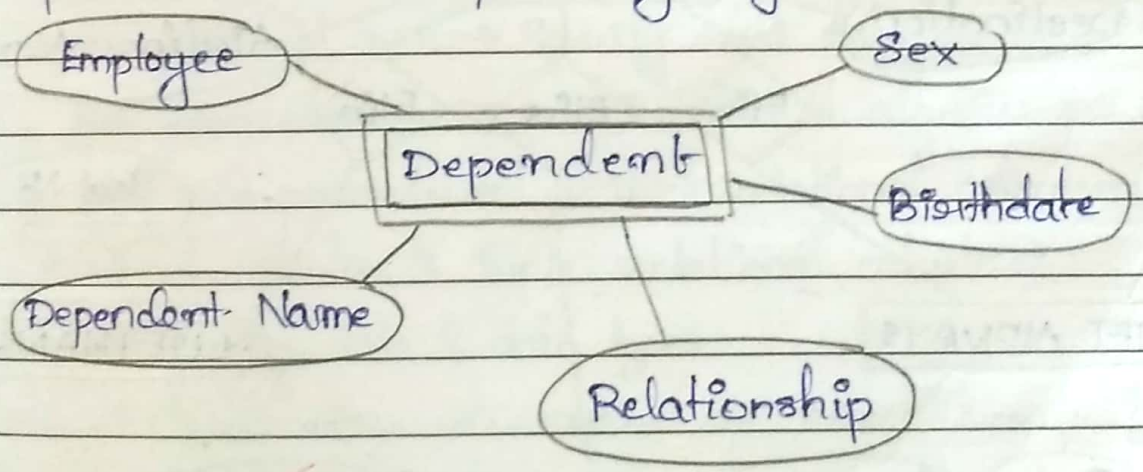


Dependent has no primary key. So it is a weak entity



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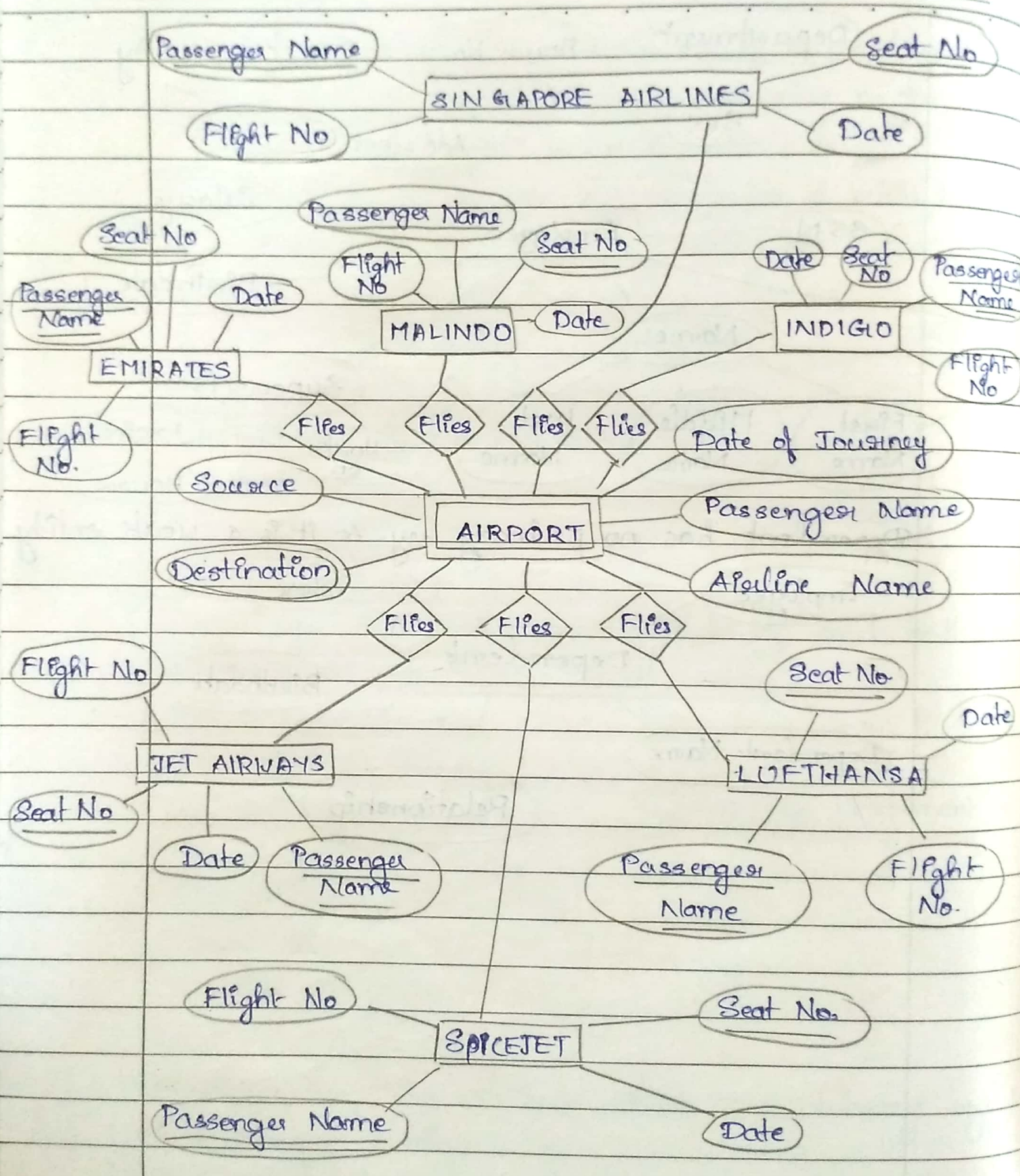

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Database Languages

- DDL → Data Definition Language
- DML → " Manipulation "
- SDL → Storage Definition "
- VDL → View " "
- DDL → Create table tablename (Attribute list with datatype)
- DML → Insert, delete, update & query

→ eg: select RollNo from Student where marks > 45

→ 2 types of DML : procedural DML & non-procedural DML

→ Procedural DML → Specify what data we need & how to retrieve those data.

→ Non-procedural DML → Specify what data we need

→ Eg. for procedural DML → Relational algebra

→ Eg. for non-procedural DML → Relational calculus (Domain relational calculus & Tuple relational calculus)

- SDL → Specify data & data types
- VDL → Create view viewname as select Name from Student where marks > 45

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College Database

Students

Admission No.	Name	Date of Birth	Stream	Batch

Streams

Stream ID	Stream Name	Seats	Years

Batches

Batch ID	Batch Name	Room	No. of Students

Staff

Staff ID	Staff Name	Branch	Class Charge

Salary

Salary ID	Staff	Payment	Date	Mode of Payment

Fees

Fees ID	Student	Amount	Date	Mode of Payment

Books

Book No	Book Title	Author	Publisher	Price

Borrowal

Borrow ID	Book	Student	Start Date	Return Date

Keys (Primary)

Students → Admission No.

Streams → {Stream ID, Stream Name}

Batches → {Batch ID, Room}

Staff → {Staff ID}

Salary → Salary ID

Fees → Fees ID

Books → Book No.

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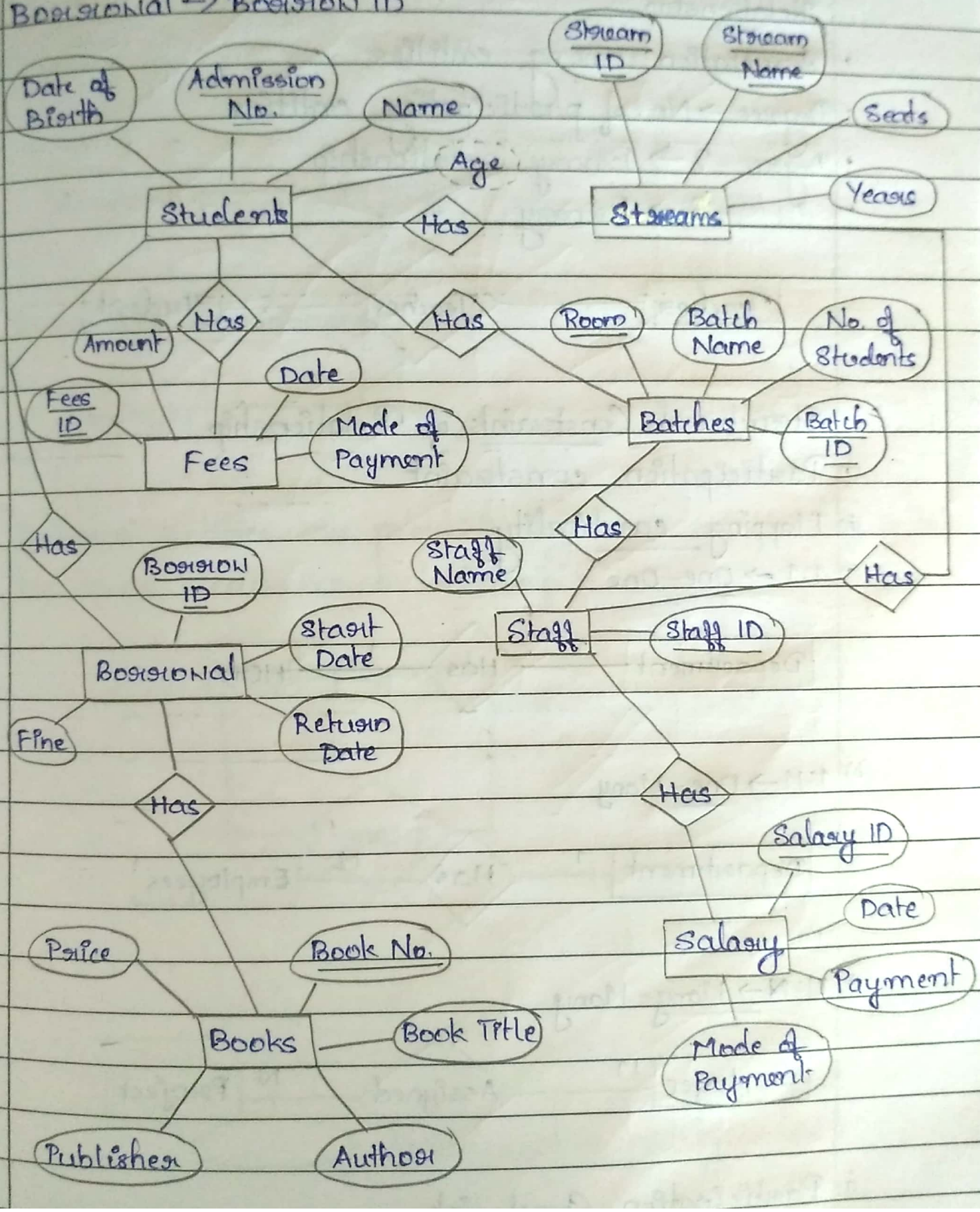
Borrowal -> Borrow ID



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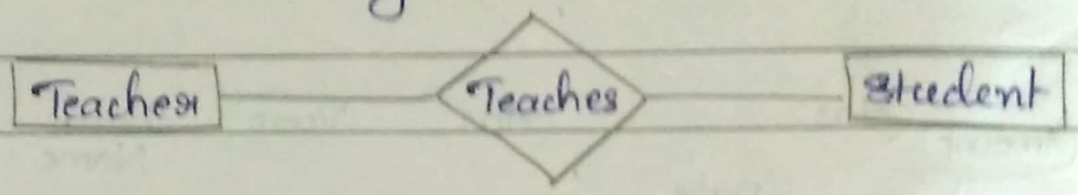
Relationship

- Association among entities
- Degree → No. of participating entities
- Degree = 2 → Binary relationship
- " = 3 → Ternary "

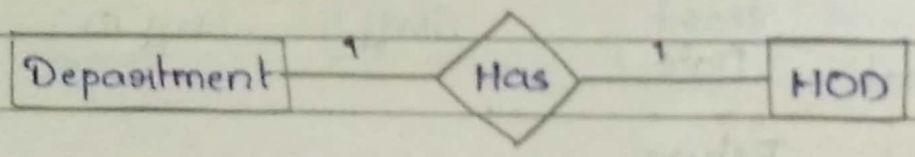


Structural Constraints of Relationship

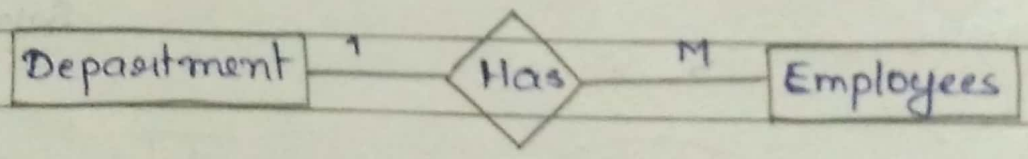
(i) Participation constraint

(ii) Mapping cardinality

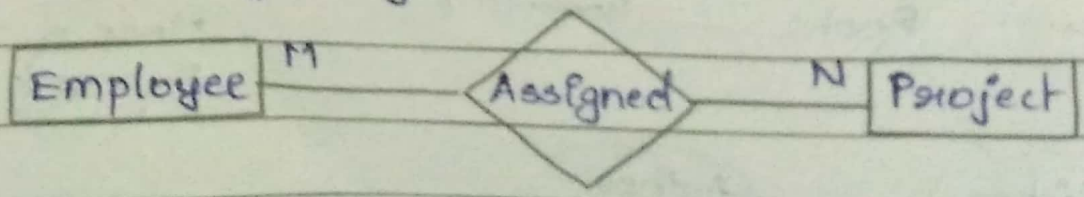
(a) 1:1 → One-One



(b) 1:M → One-Many



(c) M:N → Many-Many



(i) Participation Constraint

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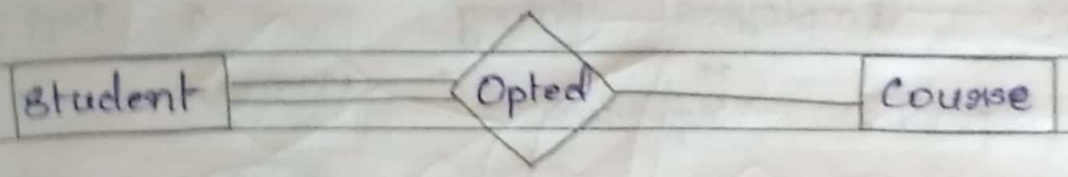
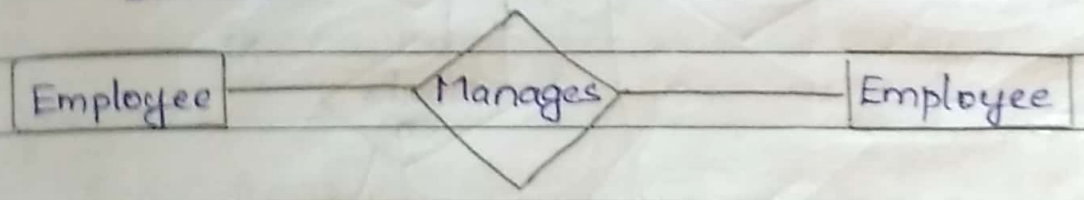
(a) Total

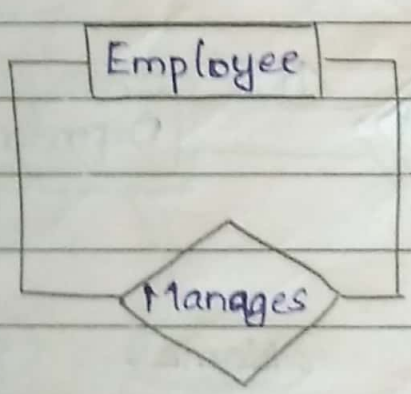
(b) Partial

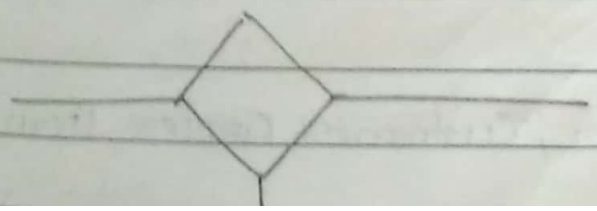


Recursive Relationship



If same entities are participating in a relationship, it is known as recursive relationship





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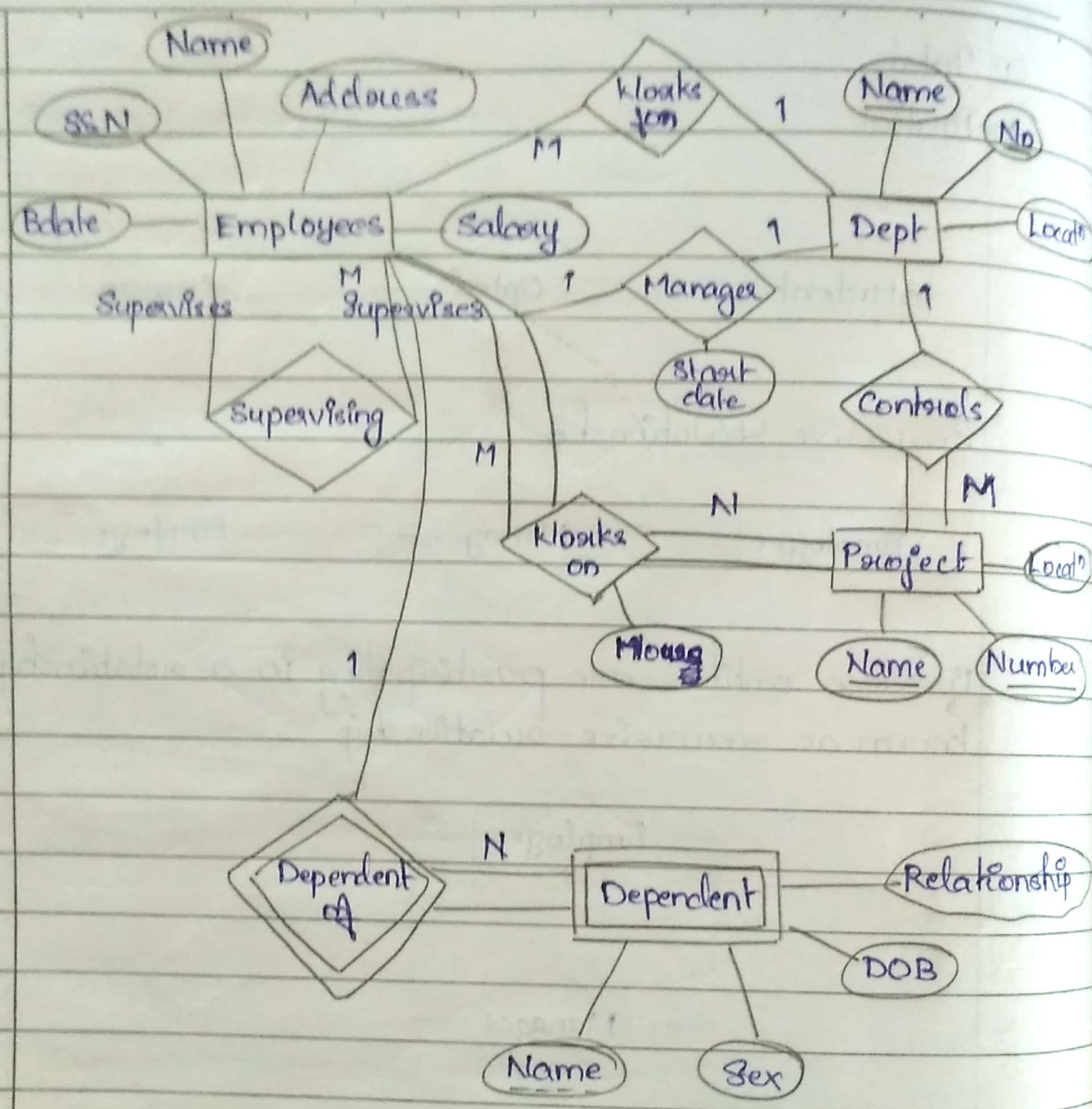

Homework Question

(i) Entities

Salesperson, Manager, Customer, Order, Item, Part, Supplier, Employee

Salesperson

SP ID, Name, ~~Address~~, DOB, Manager, Customers

Manager

MID, Name, DOB, Salespersons

Customer

CID, Name, Address, Salesperson, Orders

Order

OID, Customer, Items,

Item

IID, Name, Orders, Parts

Part

PID, Name, Items, Employees

Employee

EID, Name, Item, Parts

Supplier

SID, Name, Parts, Quantity

Primary Keys

Salesperson → SPID

Manager → MID

Customer → CID

Order → OID

Item → IID

Part → PID

Employee → EID

Supplier → SID

Relationships

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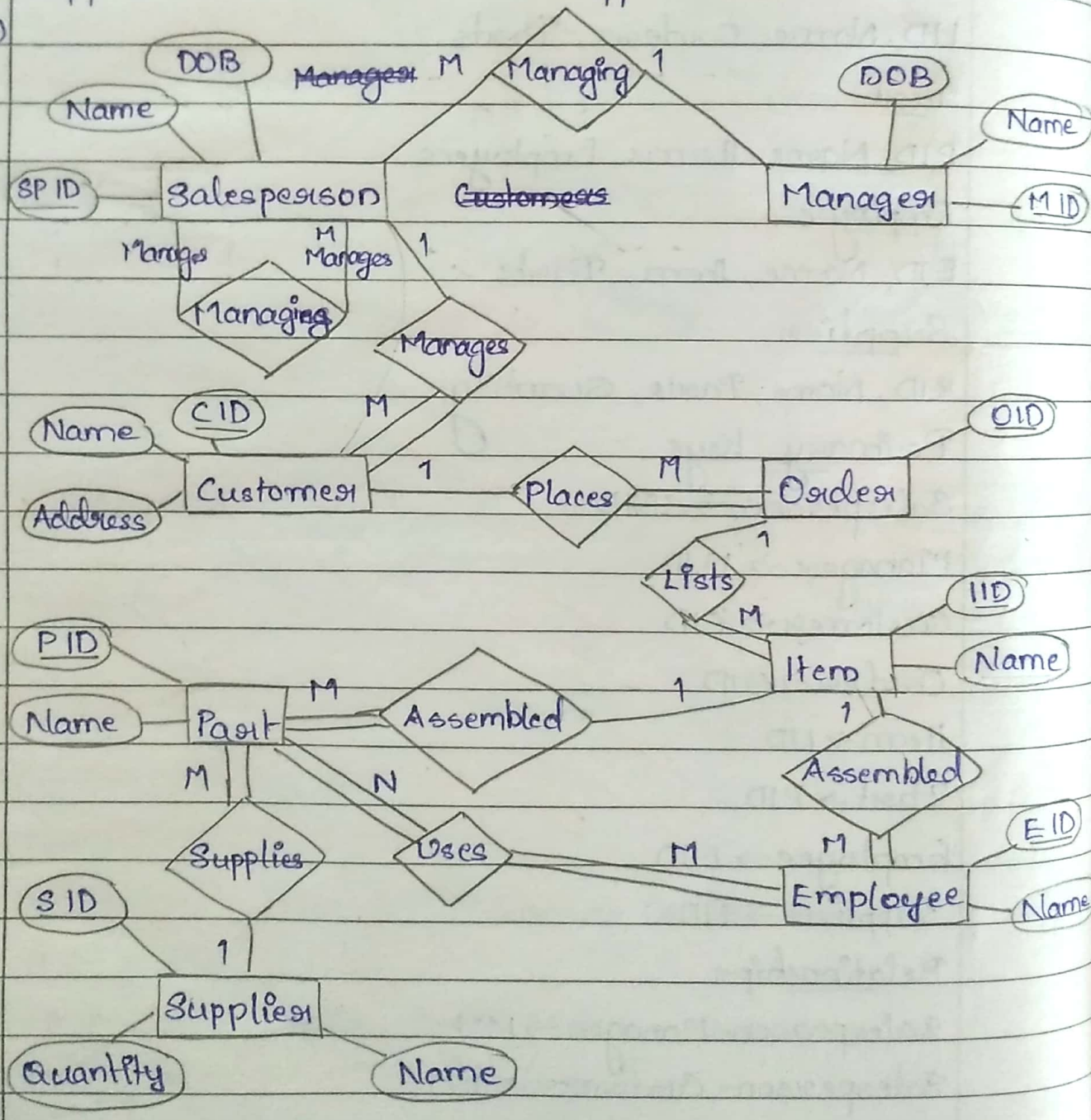
Order - Item → 1:M Item - Order → 1:M

Item - Parts → 1:M Parts - Item → 1:M

Employee - Item → M:1 Employee - Parts → M:N

Supplier - Parts → 1:M Part - Supplier → 1:M

(ii)



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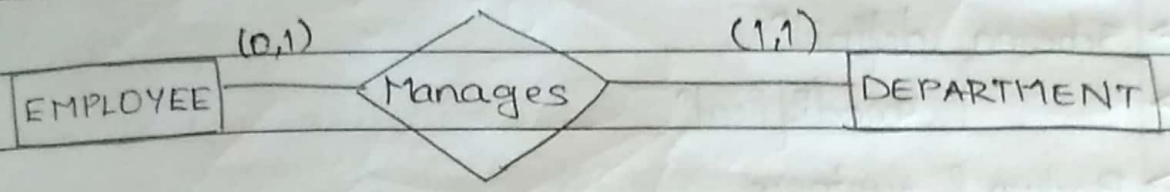
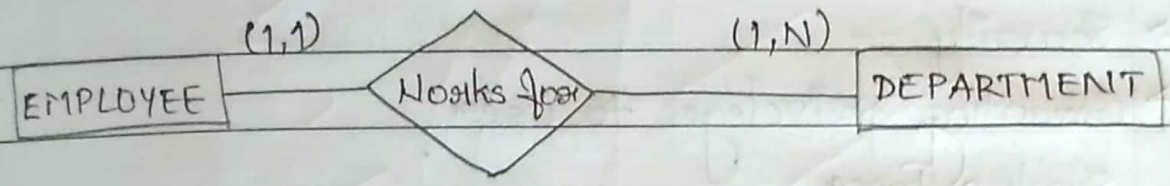
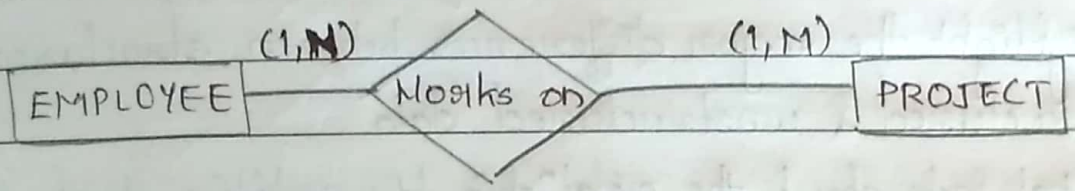
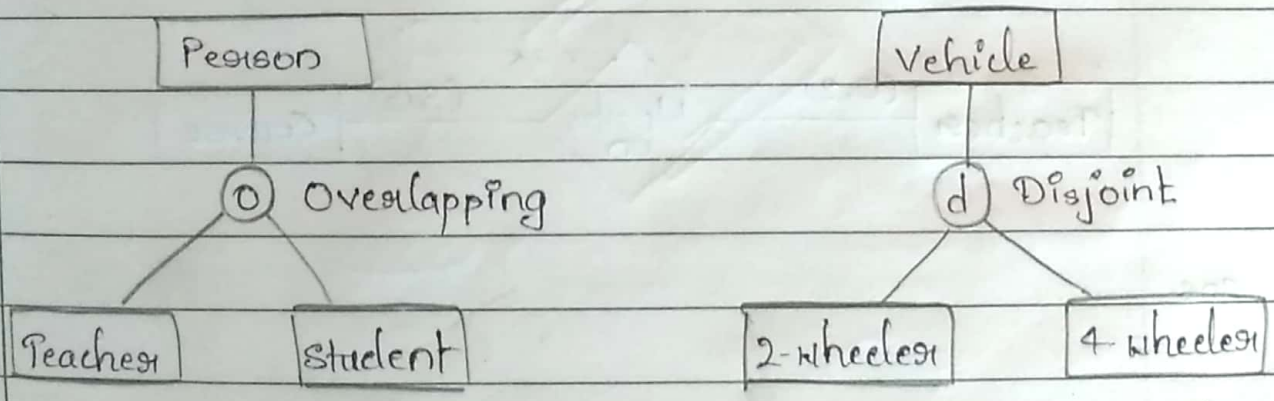
(Min, Max) Notation for Relationship Constraints







Enhanced / Extended ER Model



Actors on Screen

(i) DBA (Admin)

(ii) DB D (Designer)

(iii) END User

→ Parametric "

→ Casual end "

→ Sophisticated. " "

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→ Naive "

· DBA

→ Schema definitn

→ " modificatn

→ Backup & restore

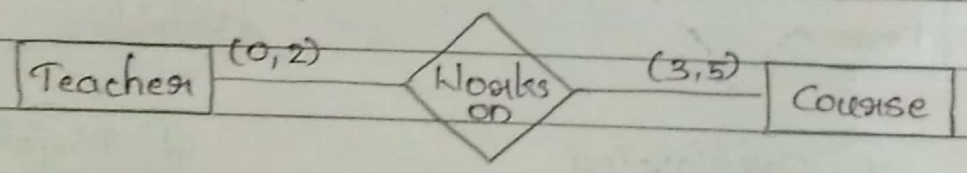
→ Security

→ Granting priveleges to user

Question Paper

① Highlight the major differences between structured, semi-structured & unstructured data.

② What facts about the relatnship btw entities teacher & course are conveyed by the following ER diagram



ans.

③ Construct an ER diagram for a hospital with a set of patients & set of medical doctors. Associate with each patient a log of various test & examinatn conducted

ans Entities (3)

Patient, Doctor, Test & Examination

Doctor (ID, Name, Specialization, Experience, DOJ)

Patient (ID, Name, DOB., DOA)

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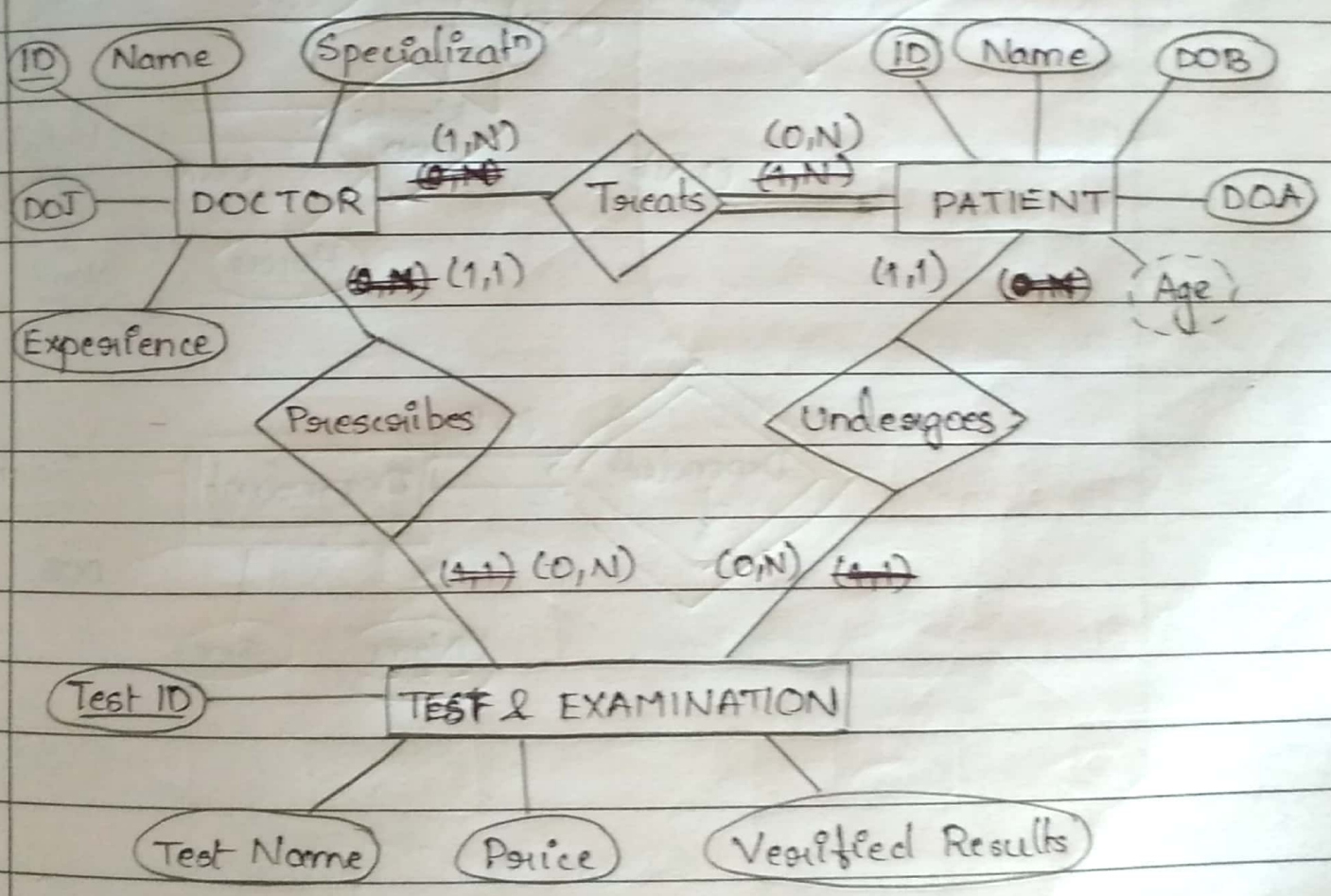
Relationships

Treats → Doctor & Patient (M:N)

Prescribes → Doctor & Test (1:M

Undergoes → Patient & Test (



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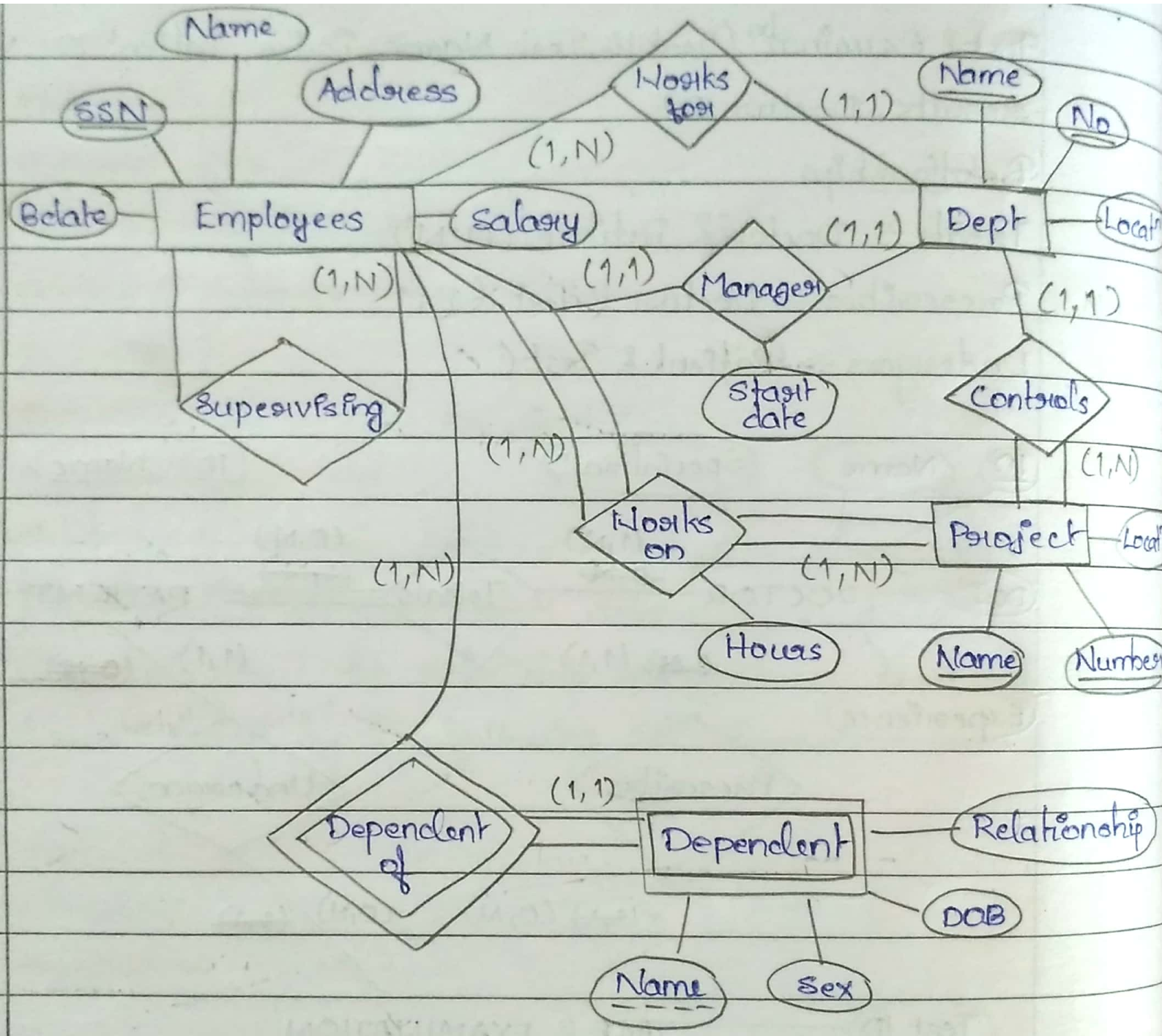

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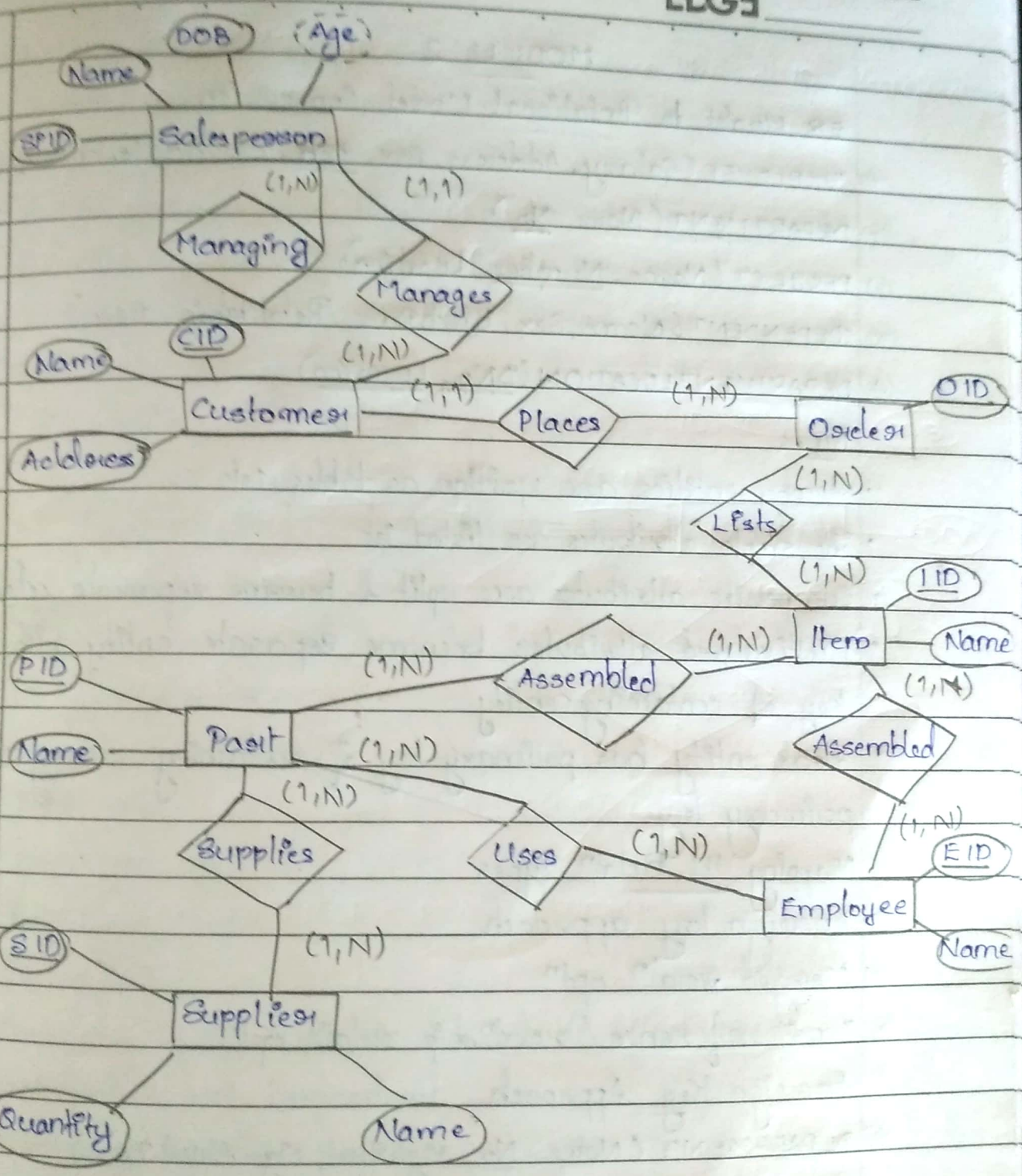

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