

Name: Anvit Gupta

Enroll: 22114009



Indian Institute of Technology Roorkee

Department of Computer Science and Engineering

Mid-semester Examination (Autumn 2024-25)

Course Name: Database Management System

Course Code: CSN-351

Instructors: Pravendra Singh, Rajat Sadhukhan

Batch: CSE & Non-CSE

Duration: 1 Hour 30 Minutes

Date: September 12, 2024

Full Marks: 100

(Instructions: There are three sections. Answer all the questions from each section. Section C contains objective type questions so no justifications needed for your answer.)

Section - A. Relational Database Design [40 marks]

- (1) Suppose that we have a relation schema $R = (A, B, C, D, E)$ with the following set F of functional dependencies holds: [4+2+2+4+]

$$A \rightarrow BC$$

$$CD \rightarrow E$$

$$B \rightarrow D$$

$$E \rightarrow A$$

The relation schema is decomposed into $R_1 = (A, B, C)$ and $R_2 = (A, D, E)$

- List the candidate keys of R
 - Compute the canonical cover F_c
 - Is the decomposition Lossless? Justify
 - Is the decomposition dependency-preserving? Justify
 - State *Pseudotransitivity rule*. Can you identify and prove one *Pseudotransitivity rule* that holds in F (You can use functional closure approach to prove your observed rule)
- (2) Consider two sets of functional dependencies as follows: [5]

$$F_1 = \{A \rightarrow C, AC \rightarrow D, E \rightarrow AD, E \rightarrow H\}$$

$$F_2 = \{A \rightarrow CD, E \rightarrow AH\}$$

Are they equivalent? Justify.

- (3) Consider a relation schema $R = (A, B, C, D, E)$ with the following set F of functional dependencies holds: [5+5]

$$F = \{A \rightarrow B, AB \rightarrow D, B \rightarrow BDE, C \rightarrow D, D \rightarrow D\}$$

Convert the relation into: ~~3NF~~

- 3NF
- BCNF

(4) Consider a relation schema as follows:

[3+3+3]

$$R = (\text{DoctorID}, \text{DoctorName}, \text{HospitalName}, \text{ChamberAddress})$$

where a *Doctor* can be associated with multiple hospitals and chambers for consultation. The superkey for *R* is $\{\text{DoctorID}, \text{DoctorName}\}$ with the following set *F* of functional dependencies holds:

$$F = \{\{\text{DoctorID}, \text{DoctorName}\} \rightarrow \{\text{HospitalName}, \text{ChamberAddress}\}\}$$

With reference to above relation answer the following questions:

- i. Name the normal form the above relation *R* can be associated with? Why?
- ii. Is there any issue with above schema ? Explain
- iii. Is there any normal form that can solve the above design issue? State the condition of such normal form and explain how you can rectify the above issue using the normal form

Section - B. Entity Relationship Model [40 marks]

(1) Suppose we have ER diagrams for the company schema (Figure 1), with structural constraints and role names [6+4+20]

- i. Name the type of attribute for: *Locations*, *Number_of_employees* corresponding to 'DEPARTMENT' entity. What is the primary key for 'DEPARTMENT' entity ?
- ii. Name the type of attribute for: *Name* corresponding to 'EMPLOYEE' entity and what type of relation is 'SUPERVISION'
- iii. Map the binary relations 'WORKS_FOR', 'MANAGES', and 'WORKS_ON' to relational schemas. Clearly mention the primary keys in your schema.

(2) Suppose you are given the following requirements for a simple database for the [10]
National Cricket League (NCL):

- i. The NCL has many teams
- ii. Each team has a name, a city, a coach, a captain, and a set of players
- iii. Each player belongs to only one team
- iv. Each player has a name, and a position (like wicket keeper, or batsman, or bowler)
- v. A team captain is also a player

Construct a clean and concise ER diagram for the NCL database. Clearly indicate the cardinality mappings in your ER diagram.

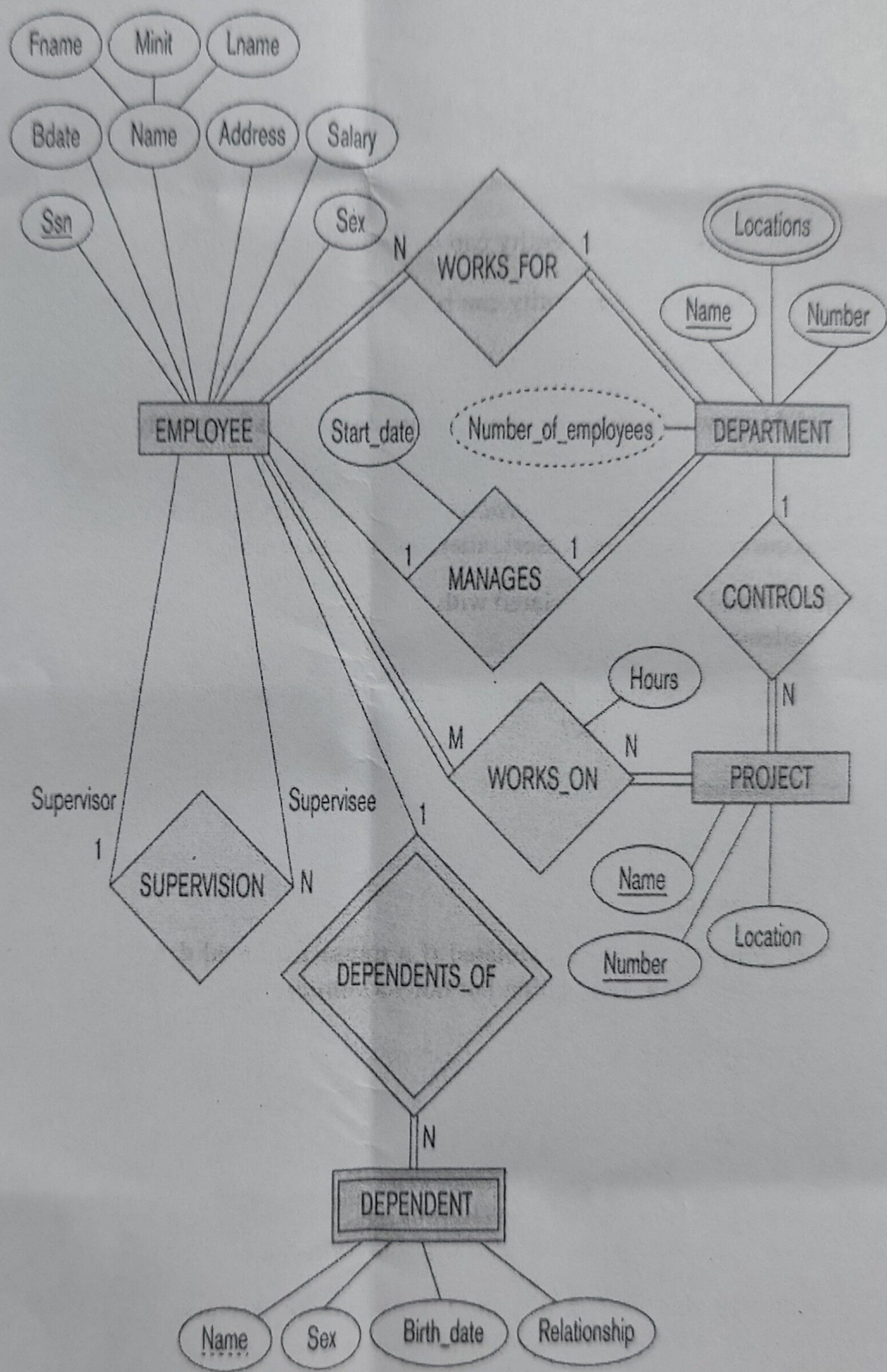


Figure 1: ER diagrams for the company schema

Section - C. Mixed bag Objective Questions [20 marks]

- (1) The _____ (*Object-oriented/Network/Distributed/Decentralized*) is not a type of database model.
- (2) The _____ (*primary/foreign/super/candidate*) is a set of one or more attributes taken collectively to uniquely identify a record.
- (3) A prime attribute of a relation scheme R is an attribute that appears in _____ (*all/some*) candidate keys of R .
- (4) Given the basic ER and relational models, which of the following is INCORRECT?
 - i. An attributes of an entity can have more than one value
 - ii. An attribute of an entity can be composite
 - iii. In a row of a relational table, an attribute can have more than one value
 - iv. In a row of a relational table, an attribute can have exactly one value or a NULL value
- (5) Data _____ (*Control/Manipulation/Definition*) Language offers the ability to query the data and insert, alter, and delete tuples.
- (6) Fifth Normal form is associated with _____ (*join/functional/multivalued*) dependency.
- (7) If a database transaction causes an update to a database that cannot be rolled back, which property is at risk?
 - i. Atomicity
 - ii. Consistency
 - iii. Isolation
- (8) Which property would be violated if a transaction read data that was modified by another concurrent transaction but not yet committed.
 - i. Atomicity
 - ii. Consistency
 - iii. Isolation
- (9) Database is an organized collection of _____ (*data / interrelated data / interrelated information / interrelated data or information*)
- (10) Which of the following is generally used for performing tasks like creating the structure of the relations, deleting relation?
 - i. DML(Data Manipulation Language)
 - ii. Relational Schema
 - iii. DDL(Data Definition Language)