

Answer Key_DBIS_2025-26_Fall

By

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1. Examine the two situations listed below, which were seen in two distinct organizations:

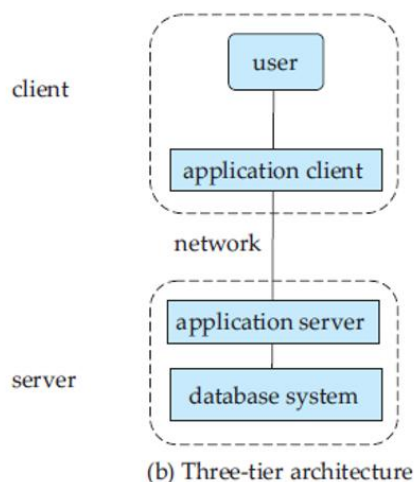
a) A global retail company intends to introduce a feature-rich online shopping platform. Consumers will use a mobile or web interface to peruse merchandise. The system uses a number of business rules when customers place orders, including figuring out shipping costs, comparing inventory across several warehouses, applying offers, and finally storing the transaction information in a central database. Additionally, the business wishes to make sure that changes to business logic, such as discount policies, may be implemented without immediately impacting the database structure or user experience.

b) A small educational university uses a lightweight software application for managing its library operations. This software is installed on each librarian's desktop, and it allows them to search for books, issue and return books, and manage student records. It does not require frequent updates, and all operations are performed within the same installed application that connects to a database maintained within the campus premises.

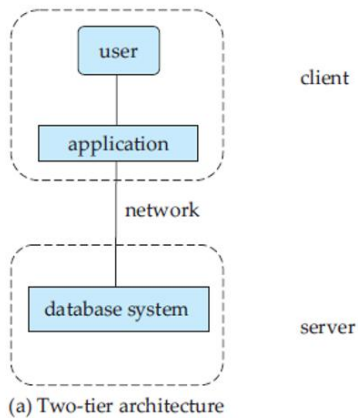
Based on the above situations, identify which architecture is more appropriate for the situation a) and situation b). Also, justify your selection by explaining how the components interact in each situation with neat diagram and why the chosen architecture is suitable.

Answer:

Situation a: Three-tier architecture: Justification and Diagram (5 marks)



Situation b: Two-tier architecture: Justification and Diagram (5 marks)



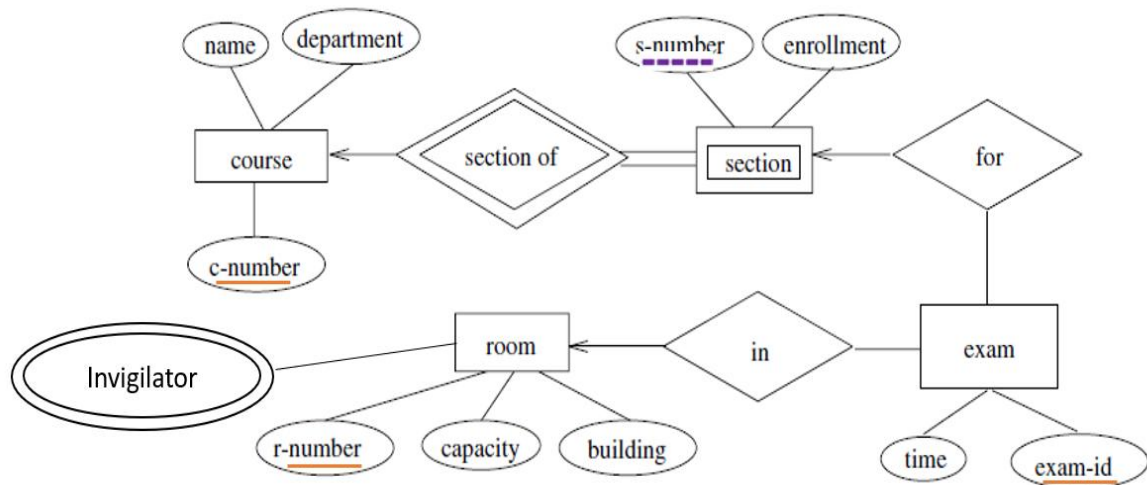
2) Explicate the key characteristics of the database management system that distinguish it from traditional file-processing systems. Illustrate each characteristic with suitable examples.

Answer:

- 1 Self-describing nature of a database system** **2.5 marks**
(Explanation + Example)
- 2 Insulation between programs and data, and data abstraction** **2.5 marks**
(Explanation + Example)
- 3 Support of multiple views of the data** **2.5 marks**
(Explanation + Example)
- 4 Sharing of data and multiuser transaction processing** **2.5 marks**
(Explanation + Example)

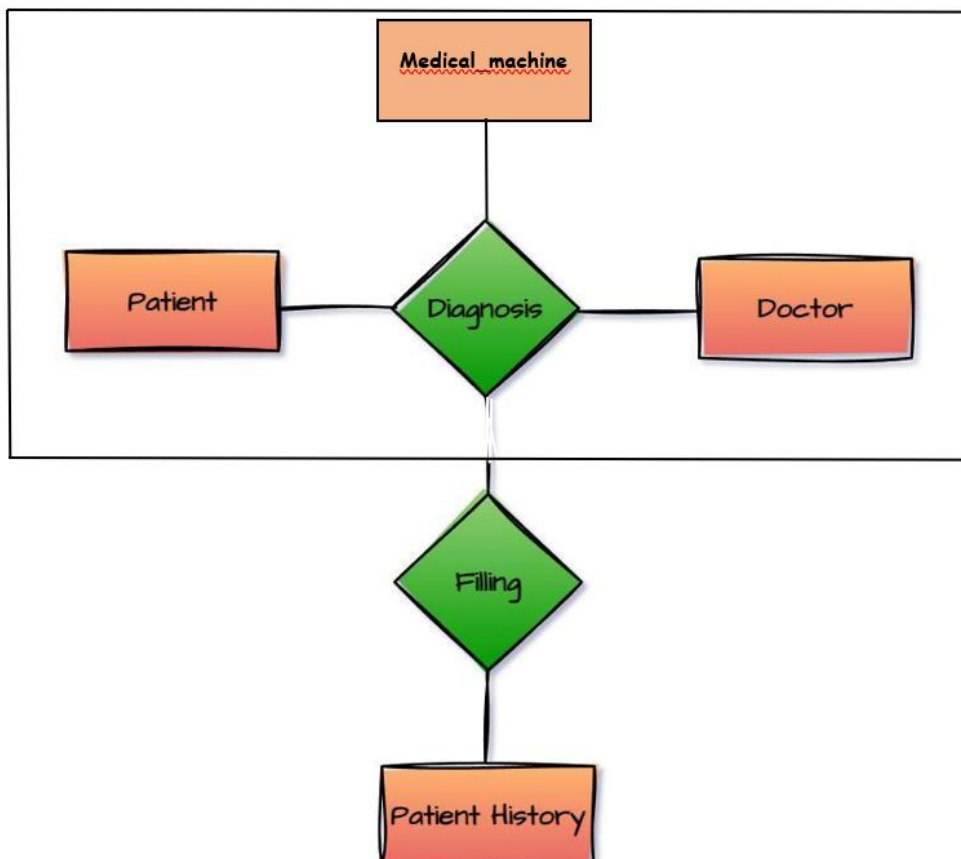
3.a) Consider a university database for the scheduling of classrooms for semester exams. This database could be modeled as the single entity set Exam, with attributes time and primary key exam_id. Along with this, three more entity sets such as entity set Course with attributes name, department, and primary key c-number, entity set Section with attributes enrolment and partial key s-number and dependent as a weak entity set on Course and entity set Room with attributes capacity, building, invigilator (s), and primary key r-number. Room is associate with several Exams via relationship set but Exam is associated with at most one Room. Also, section is associated with several exams via another relationship set but Exam is associate with at most one Section. Draw an E-R diagram illustrating an above scenario of an application.

Answer: ER diagram is given below. (5 marks)



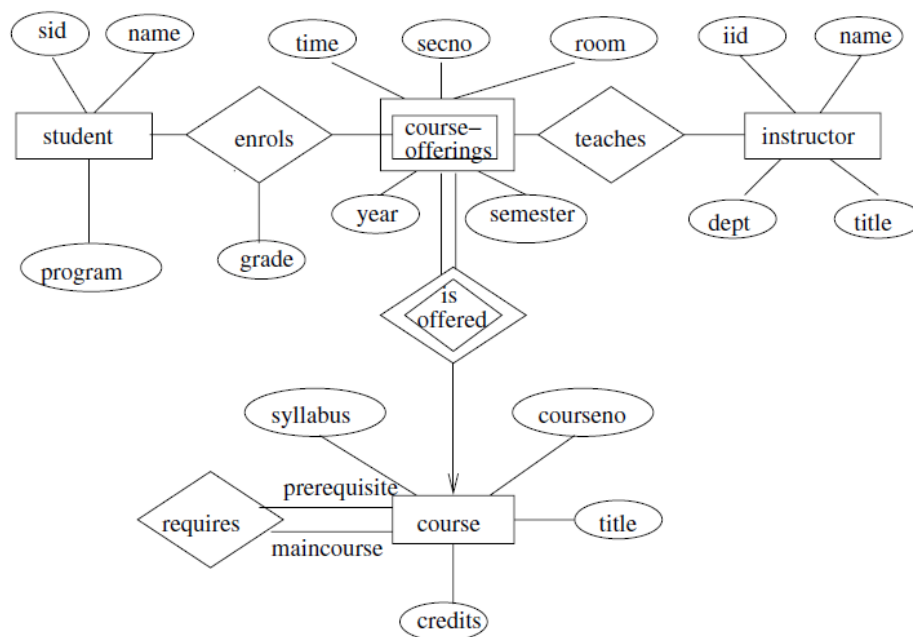
b) In a hospital, each patient is diagnosed by a doctor using medical machine. Later, hospital is decided to file these diagnosis details in the patient's medical history. Model this scenario using an EER diagram with appropriate use of aggregation. Justify why aggregation is necessary in this case.

Answer: EER Diagram + Justification (5 marks)



4. Consider the following ER diagram for a university application. In the given entity sets, primary keys are sid, iid, courseno while the discriminators are time, secno and room. Undirected and directed line represents “many” and “one” relationship respectively. Convert this ER diagram into relational model that includes representations for strong entity sets, weak entity sets and all types of relationship set. – 8 marks

In addition to this, Dean has requested two updates to the ER diagram: a) The Student should be updated to include a mobile number. A student may have multiple mobile numbers. b) The instructor should be updated to include an address, which consists of four subcomponents: door_no, street, city, and pincode. Update the relational schemas according to the changes made. – 2 marks



Answer:

Part A – 8 marks

Representation of strong entity sets:

student (sid, name, program)

instructor (iid, name, dept, title)

course (courseno, title, credits, syllabus)

Representation of weak entity sets:

course offerings (courseno, time, secno, room, year, semester)

Representation of relationship sets:

1. many to one relationship set:

is_offered (courseno, time, secno, room)

2. many to many relationship sets:

enrols (sid, courseno, time, secno, room, grade)

teaches (iid, courseno, time, secno, room)

Redundancy of schema: (since we have not asked this in a question, no need to write this. So, we don't want to consider this for marks. In case, they written, it is appreciable)

Whatever attributes are there in is_offered relationship set, all are there in course_offerings entity set also. So, is_offered is redundant relationship set. It can be avoided.

Part B – 2 marks

In addition to this, Dean has requested two updates to the ER diagram

a) The student should be updated to include a mobile number. A student may have multiple mobile numbers.

Representation of Entity Sets with Multivalued Attributes:

Student_mobile (sid, mobile_number)

b) The instructor should be updated to include an address, which consists of four subcomponents: door_no, street, city, and pincode.

Representation of Entity Sets with Composite Attributes:

instructor (iid, name, dept, title, door_no, street, city, pincode)

5. A university library maintains a record of borrowed books in the following unnormalized table: Column header expansion given below.

srn – student register no, sname – student name, sph – student phone no,

bid – book id, bname – book name, bd – borrow date, rd – return date,

hbn – hostel block no, hbn – hostel block name.

Here, srn and bid are primary keys. bd and rd must be determined by both primary keys srn and bid.

Given the following unnormalized table, convert it step by step into First Normal Form (1NF), Second Normal Form (2NF), and Third Normal Form (3NF), if violations of the corresponding normal forms exist. For each step, clearly identify the violation, justify why it violates the normal form, and then provide the appropriate decomposition to achieve the respective normal form.

| <u>srn</u> | <u>bid</u> | sname | sph | bname | bd | rd | hbn | hbname |
|------------|------------|-------|---------------------------|-------|----------|----------|-----|--------|
| S1 | B1 | x | 9876543210, 9123456780 | DBMS | 25-08-01 | 25-08-15 | A | Anna |
| S2 | B2 | y | 9988776655 | OS | 25-08-02 | 25-08-16 | B | Gandhi |
| S3 | B3 | z | 8899001122, 9000112233 | CN | 25-08-03 | 25-08-17 | C | Nehru |
| S4 | B4 | w | 9090909090 | AI | 25-08-04 | 25-08-18 | D | Patel |

UNF:

Library (srn, bid, sname, sph, bname, bd, rd, hbn, hbname)

1NF: (Identification and Justification of NF with decomposition) – 3 marks

Rule: Only attribute values permitted are single atomic (or indivisible) values.

But, here sph contains multiple values for many rows. So, it is considered as multivalued attribute. So, it is violated the 1 NF. Solution is decomposition.

Library (srn, bid, sname, bname, bd, rd, hbn, hbname)

Library_ph (srn, bid, sph)

Now it is in 1NF

2NF: (Identification and Justification of NF with decomposition) – 3 marks

Rule: Based on concept of full functional dependency and should not have partial dependency

- In the above two relations, partial FD is there.
- **In library schema**, as per the statement given in an question, “bd and rd must be determined by both primary keys srn and bid”. So, this is Full FD. No violation here.
- But, srn alone can determine sname, hbn and hbname. This is Partial FD. 2NF is violated here.
- Also, bid alone can determine bname. This is also Partial FD. 2NF is violated here.
- Solution is decomposition.

Library1 (srn, bid, bd, rd)

Library2 (srn, sname, hbn, hbname)

Library3 (bid, bname)

Library_ph (srn, bid, sph)

3NF: (Identification and Justification of NF with decomposition) – 4 marks

Rule:

Definition. According to Codd's original definition, a relation schema R is in 3NF if it satisfies 2NF *and* no nonprime attribute of R is transitively dependent on the primary key.

- In the above relations, only library2 schema is violated the 3NF.
- **In library2 schema**, srn determines hbn and turn hbn determines hbname. So, here hbname is transitively dependent on primary key srn. So, it is a violation.
- Solution is decomposition.

Library1 (srn, bid, bd, rd)

Library21 (srn, sname, hbn)

Library22 (hbn, hbname)

Library3 (bid, bname)

Library_ph (srn, bid, sph)