BSCCS2001: Graded Assignment with Solutions
Week 4

1. Consider the relations shown in Figure 1. [MSQ: 2 points]

CAR

NAME	MADE	COST
CAR-A	COM-X	200
CAR-B	COM-X	100
CAR-A	COM-Z	300
CAR-B	COM-Y	300
CAR-B	COM-Z	400
CAR-C	COM-X	100
CAR-D	COM-Y	200
CAR-D	COM-X	300

COSTING

MADE	COST
COM-X	100
COM-Z	400

Figure 1: Relations **CAR** and **COSTING**

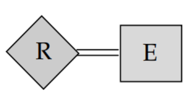
Which car name(s) will be displayed by the operation $CAR \div COSTING$?

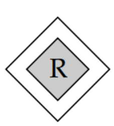
- ○ CAR-A
- √ CAR-B
- ○ CAR-D
- ○ CAR-A, CAR-B

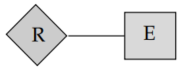
Solution: The relation returned by the division operation must have attributes that are in **CAR** but not in **COSTING**. Thus, the returned relation will have only one attribute *NAME*.
The returned relation must have those tuples from relation **CAR** which are associated to every tuple from **COSTING**. Thus, in this case it will be **CAR-B**.

2. Which of the following symbols is used in the ER-diagrams to represent "total participation of an entity set in a relationship"?

[MCQ: 1 point]

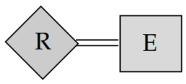
√ 

○ 

○ 

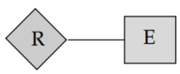
○ None of the above

Solution:



represents total participation of an entity set in a relationship.

represents identifying relationship set for weak entity.



represents partial participation of an entity set in a relationship.

3. Choose the relational algebra expression that is equivalent to the following tuple calculus expression: [MCQ: 1 point]

   $\{t \mid t \in r \wedge (t[A] = 50 \wedge t[B] = 90)\}$

   ○ $\sigma_{(A=50 \vee B=90)}(r)$

   ○ $\sigma_{(A=50)}(r) \cup \sigma_{(B=90)}(r)$

   √ $\sigma_{(A=50)}(r) \cap \sigma_{(B=90)}(r)$

   ○ $\sigma_{(A=50)}(r) - \sigma_{(B=90)}(r)$

Solution: Select Operator (σ) selects those rows or tuples from a relation that satisfies the selection condition.
Option 1: It will fetch the tuples having $A = 50$ or $B = 90$.
Option 2: It calculates union of tables having $A = 50$ and $B = 90$ separately.
Option 3: It is valid as it calculates the intersection of tables having $A = 50$ and $B = 90$ separately.
Option 4: The MINUS operator is used to subtract the result set obtained by $\sigma_{(A=50)}(r)$ from the result set obtained by $\sigma_{(B=90)}(r)$, thus it will return only those rows which have tuple $A = 50$ and not those rows which are common to both $A = 50$ and $B = 90$.

4. A bank consists of several **Person** entities. The **Person** entities may have two special types: **Employee** and **AccountHolder**. However, there is a possibility that some **Person** entities are neither an **Employee** nor an **AccountHolder** (like a visitor at the bank). Again, some **Person** entities can be of both **Employee** and **AccountHolder** types. [MCQ: 2 points]
   Identify the constraints on specialization with respect to the above scenario.

   ◯ Disjoint and partial

   √ Overlapping and partial

   ◯ Disjoint and total

   ◯ Overlapping and total

Solution:

- As a **Person** can be an **Employee** or an **AccountHolder** or just a **Person** (like a visitor at the bank), it is partial specialization.
- As a **Person** can be both **Employee** and **AccountHolder**, it is overlapping specialization.

5. Consider the E-R diagram given in Figure 2. [MSQ: 1 point]

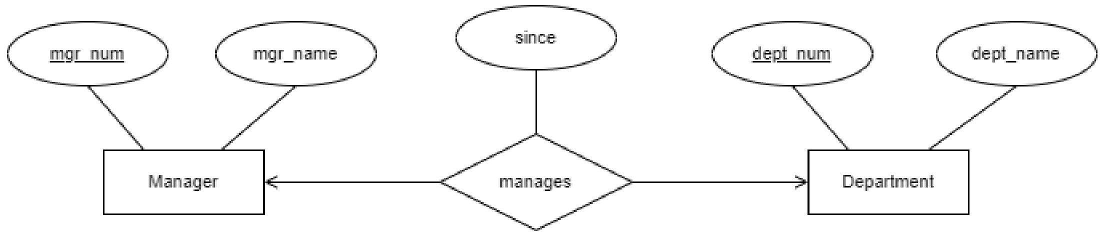


Figure 2: E-R diagram

Identify the option(s) that correctly represent(s) the corresponding tables for the given E-R diagram.

- ◯ **Manager**($\underline{mgr\_num}$, mgr_name)
  manages(mgr_num, $dept\_name$, $since$)
  Department($\underline{dept\_num}$, $dept\_name$)
- √ **Manager**($\underline{mgr\_num}$, mgr_name)
  Department($\underline{dept\_num}$, mgr_num, $dept\_name$, $since$)
- √ **Manager**($\underline{mgr\_num}$, $dept\_num$, mgr_name, $since$)
  Department($\underline{dept\_num}$, $dept\_name$)
- ◯ **Manager**($\underline{mgr\_num, dept\_num}$, mgr_name, $since$)
  Department($\underline{dept\_num}$, $dept\_name$)

Solution: manages is a one-to-one relationship set between **Manager** and **Department**.
The E-R diagram can be mapped to the tables using either of the following:

- **Manager**($\underline{mgr\_num}$, mgr_name)
- **Department**($\underline{dept\_num}$, mgr_num, $dept\_name$, $since$)

or

- **Manager**($\underline{mgr\_num}$, $dept\_num$, mgr_name, $since$)
- **Department**($\underline{dept\_num}$, $dept\_name$)

6. Consider the relations below: [MSQ: 3 points]

   - **doctor**($\underline{doc\_id}$, doc_name, $specialization$)
   - **patient**($\underline{patient\_num}$, $patient\_name$)
   - **operationRoster**($\underline{doc\_id, patient\_num}$, $operation\_cost$)

   Identify the appropriate expression(s) to find all the distinct names of the patients operated either by "Dr. Nath" or by "Dr. Joseph".

   √ $\prod_{patient\_name}(patient \bowtie \prod_{patient\_num}$
   $(\sigma_{doc\_name=\text{“Dr. Nath”} \lor doc\_name=\text{“Dr. Joseph”}}$
   $(doctor \bowtie operationRoster)))$

   ○ $\prod_{patient\_name}(patient \bowtie \prod_{patient\_num}$
   $(\sigma_{doc\_name=\text{“Dr. Nath”} \lor doc\_name=\text{“Dr. Joseph”}}$
   $(doctor \times operationRoster)))$

   √ $\prod_{patient\_name}(\sigma_{doc\_name=\text{“Dr. Nath”}}((patient \bowtie (doctor \bowtie operationRoster)))) \cup$
   $\prod_{patient\_name}(\sigma_{doc\_name=\text{“Dr. Joseph”}}((patient \bowtie (doctor \bowtie operationRoster))))$

   ○ $\prod_{patient\_name}(patient \bowtie \prod_{patient\_num}$
   $(\sigma_{doc\_name=\text{“Dr. Nath”} \lor doc\_name=\text{“Dr. Joseph”} \lor doctor.doc\_id=operationRoster.doc\_id}$
   $(doctor \times operationRoster)))$

Solution: Option-1 does the following:

1. Apply natural join between **doctor** and **operationRoster**, thus, combines the tuples based on the equality on *doc_id* on both the relations.
2. Then, apply select operation to extract the tuples having *doc_name* as either "Dr. Nath" or "Dr. Joseph".
3. Then, project *patient_num* from the selected tuples.
4. Again, perform natural join between selected *patient_num* tuples with **patient**. Thus, combines the tuples based on the equality on *patient_num* on both the relations.
5. Finally, project the *patient_name*.

Hence, option-1 is **correct**.
In option-2, instead of natural join, Cartesian product has been applied. Since it combines all tuples from **doctor** with all the tuples from **operationRoster**, it is **wrong**.
In option-3, first natural join is applied between **doctor** and **operationRoster** based on equality on *doc_id*. Then, again natural join is applied between the resultant

tuples and **patient** based on equality on $patient\_num$. Then, select the tuples having doc_name = "$Dr.\ Nath$" and project the $patient\_name$.
The same natural join is again applied between **doctor**, **operationRoster** and **patient**. Then, select the tuples having doc_name = "$Dr.\ Joseph$" and project the corresponding $patient\_name$.
Finally, apply union between two sets of tuples. Hence, the option-3 is **correct**.
In option-4, the predicate used for selection is:
doc_name = "$Dr.\ Nath$" $\vee$ doc_name = "$Dr.\ Joseph$"
$\vee$ $doctor.doc\_id = operationRoster.doc\_id$ which is **incorrect**.
The correct form of the predicate is:
(doc_name = "$Dr.\ Nath$" $\vee$ doc_name = "$Dr.\ Joseph$") $\wedge$ ($doctor.doc\_id = operationRoster.doc\_id$).

7. Consider the E-R diagram given in Figure 3.

[MCQ: 2 points]

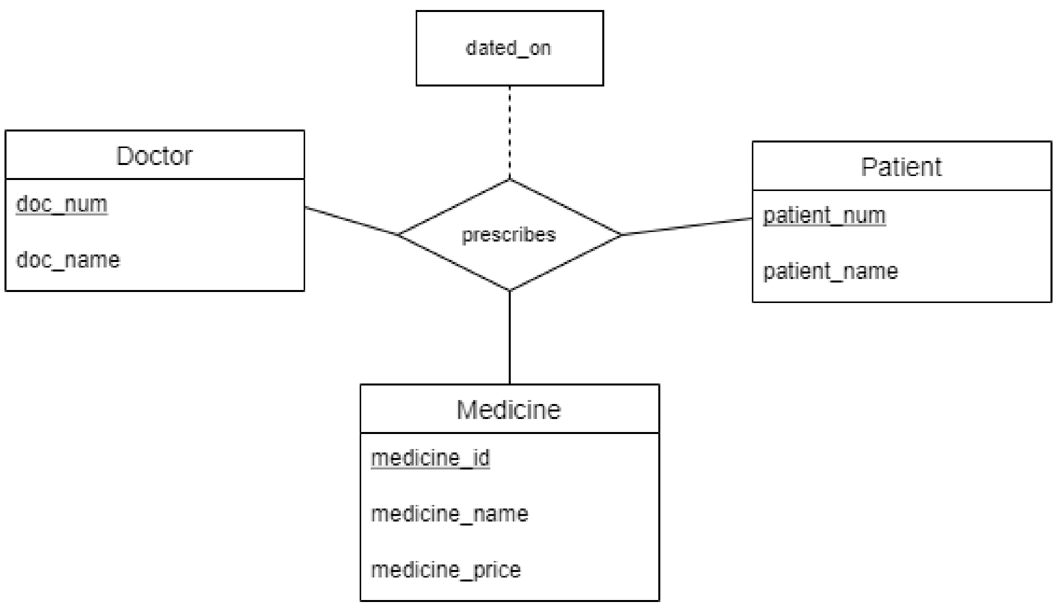


Figure 3: E-R diagram

What will be the schema for the tables corresponding to the relationship set **prescribes**?

- ◯ **prescribes**($\underline{doc\_num}, patient\_num, medicine\_id$)
- ◯ **prescribes**($\underline{doc\_num}, patient\_num, medicine\_id, dated\_on$)
- ◯ **prescribes**($\underline{doc\_num}, \underline{patient\_num}, \underline{medicine\_id}$)

$\surd$ **prescribes**($\underline{doc\_num}$, $\underline{patient\_num}$, $\underline{medicine\_id}$, $dated\_on$)

Solution: In the given E-R diagram, there is a ternary relationship with many-to-many relations between the entity sets **Doctor**, **Patient** and **Medicine**. As in the case of binary relationships, the ternary relationship set **prescribes** must also be mapped to a table with attributes as follows:

- the primary keys from all the entity sets associated via the relationship set,
- any descriptive attribute of the relationship set.

Thus, the schema for **prescribes** is:
prescribes($\underline{doc\_num}$, $\underline{patient\_num}$, $\underline{medicine\_id}$, $dated\_on$).

Consider the E-R diagram given in Figure 4 and answer the questions 8 to 10.

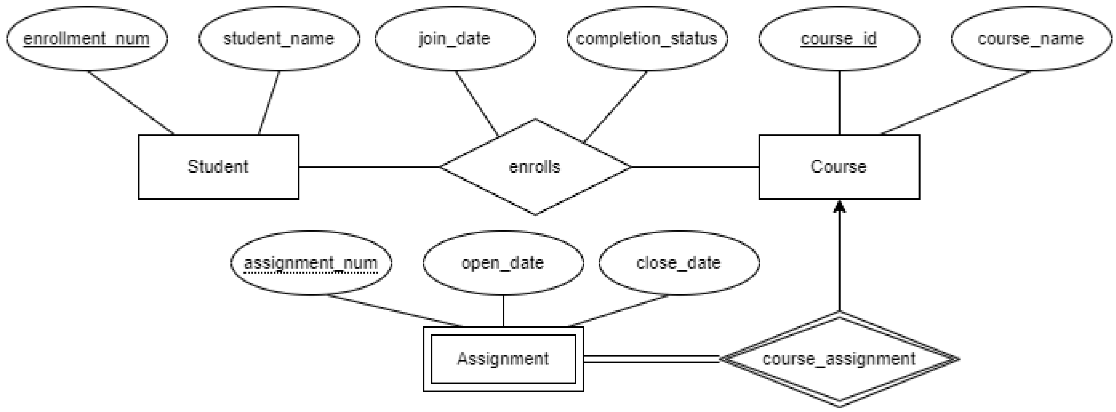


Figure 4: E-R diagram

8. Identify the correct relational schema for the relationship set **enrolls**.

[MCQ: 2 points]

Note: The primary key is underlined.

- ○ $\textbf{enrolls}(\underline{\textit{join\_date}}, \underline{\textit{completion\_status}})$
- ○ $\textbf{enrolls}(\underline{\textit{enrollment\_num}}, \textit{join\_date}, \textit{completion\_status})$
- ○ $\textbf{enrolls}(\underline{\textit{course\_id}}, \textit{enrollment\_num}, \textit{join\_date}, \textit{completion\_status})$
- √ $\textbf{enrolls}(\underline{\textit{course\_id}}, \underline{\textit{enrollment\_num}}, \textit{join\_date}, \textit{completion\_status})$

> **Solution:** As the relationship is many-to-many, the schema for **enrolls** must have primary keys from the associated entity sets and the descriptive attributes of the relationship set. Hence, the right option is:
> $\textbf{enrolls}\ (\underline{\textit{course\_id}}, \underline{\textit{enrollment\_num}}, \textit{join\_date}, \textit{completion\_status})$

9. Identify the correct relational schema for the entity set **Assignment**.

[MCQ: 3 points]

Note: The primary key is underlined.

- ○ $\textbf{Assignment}(\underline{\textit{assignment\_num}}, \textit{open\_date}, \textit{close\_date})$
- √ $\textbf{Assignment}(\underline{\textit{course\_id}}, \underline{\textit{assignment\_num}}, \textit{open\_date}, \textit{close\_date})$
- ○ $\textbf{Assignment}(\textit{assignment\_num}, \underline{\textit{course\_id}}, \textit{open\_date}, \textit{close\_date})$
- ○ $\textbf{Assignment}(\underline{\textit{assignment\_num}}, \textit{course\_id}, \textit{open\_date}, \textit{close\_date})$

Solution: Please note that **Assignment** is a weak entity which is identified by the strong entity **Course**. **Assignment** has total participation in the relationship and it is associated with **Course** via **course_assignment** as a many-to-one relationship. Thus, the primary key of **Course** (one-side) entity set will be added to the relational schema for **Assignment** and it also becomes part of the primary key (cannot be null because of total participation). So the schema is:
Assignment *(<u>course_id</u>, <u>assignment_num</u>, open_date, close_date)*

10. With reference to the relationship between **Student** and **Course**, which of the statement(s) is/are **TRUE**?

[MSQ: 3 points]

- ◯ Each course must have at least one student.
- ◯ Each student must have enrolled for at least one course.
- √ Some courses may have no students.
- √ A student may enroll for many courses.

Solution: **enrolls** is a many-to-many relationship set between **Student** and **Course** entity sets.
As each course may be associated with 0 to n students, option-1 is wrong.
As each student can enroll from 0 to n courses, option-2 is also wrong.
However, option-3 and option-4 are correct.