Database Management System: Assignment 1

Total Marks : 20

July 6, 2023

Question 1

Which of the following statements is (are) correct? *Marks: 2* **MSQ**

a) Physical level abstraction describes how a record is stored.

b) View level abstraction hides details of data types.

c) Physical level abstraction describes data stored in a database and their relationships.

d) Logical level abstraction defines the physical schema.

Answer: a), b)
Explanation: As per the lecture notes (Module 02: Introduction to DBMS/1).
Physical level: describes how a record is stored.
Logical level: describes data stored in the database, and the relationships among the data.
View level: application programs hide details of data types.

Question 2

Consider the following relations:
`Subject(sid, sname, credit)`
`Faculty(fid, sid)`
Consider the following Relational Algebras:

RA_1 : $\Pi_{\texttt{Subject.sid, sname}}(\texttt{Subject} \bowtie \texttt{Faculty})$
RA_2 :$\Pi_{\texttt{Subject.sid, sname}}(\texttt{Subject} \times \texttt{Faculty})$

Which of the following is correct? *Marks: 2* **MCQ**

a) $RA_1 \subset RA_2$

b) $RA_2 \subseteq RA_1$

c) $RA_1 \subseteq RA_2$

d) $RA_1 = RA_2$

Answer: c)
Explanation: Natural join projects only those tuples where the sid matches. Cartesian product projects all tuples after cross-product.
Hence, option (c) is correct.

Question 3

What does the following Relational Algebra expression return? *Marks: 2* **MCQ**

$\Pi_{\texttt{height}}(\texttt{Mountain}) - \Pi_{\texttt{Mountain.height}}(\sigma_{\texttt{Mountain.height<m.height}}(\texttt{Mountain} \times \rho_m(\texttt{Mountain})))$

a) All heights except the maximum height from `Mountain` relation.

b) All heights except the minimum height from `Mountain` relation.

c) Minimum height from `Mountain` relation.

d) Maximum height from `Mountain` relation.

Answer: d)
Explanation: As per the syntax of the relational algebra.

Question 4

Consider the relational schema `PhoneBook(Name, PhoneNo, Location, LastCalled)`.

If the tuple | `Ankit` | `2222586110` | `Kolkata` | `15 Jul` | is present in an instance of `PhoneBook`, which of the following tuples can NOT be inserted to `PhoneBook`?

Marks: 2 **MCQ**

a) | `Ankit` | `3222265783` | `Kolkata` | `15 Jul` |

b) | `Shreya` | `3222265783` | `Delhi` | `16 Jul` |

c) | `Ankit` | `2222586110` | `Delhi` | `16 Jul` |

d) | `Shreya` | `2222586110` | `Kolkata` | `15 Jul` |

Answer: (c)
Explanation: According to the given relational schema, `Name, PhoneNo` combined forms the primary key of `PhoneBook` and hence, must be unique and non-null. Since, `Ankit, 2222586110` is present in the instance and uniquely identifies `Location` and `LastCalled` as `Kolkata` and `15 Jul`, the tuple shown in option (c) cannot be inserted. Hence, option (c) is the answer.

Question 5

Consider the relation `Flight(FlightNo, Source, Destination, Duration)` where {`FlightNo`} and {`Source, Destination, Duration`} are the 2 candidate keys. What is the possible number of superkeys of `Flight`?

Marks: 2 **MCQ**

a) 8

b) 9

c) 10

d) 16

Answer: (b)
Explanation: Total number of superkeys of `Flight` = Superkeys of `Flight` with {`FlightNo`} as the key only + Superkeys of `Flight` with {`Source, Destination, Duration`} as the key only - Superkeys of `Flight` with both {`FlightNo`} and {`Source, Destination, Duration`} as the keys
$= 2^{4-1} + 2^{4-3} - 2^{4-4} = 9$. Hence, option (b) is correct.

Question 6

Consider a truth table having the following columns

P	Q	R=((P $\vee$ Q) $\rightarrow \neg$P)	S=((P $\vee$ Q) $\rightarrow$ P)

If the truth table, with all the values, is represented as a relational instance, which column(s) (attribute(s)) should be chosen as candidate keys? *Marks: 2* **MSQ**

a) {P,R}

b) {P,Q}

c) {Q,R}

d) {Q,S}

Answer: (b), (c)
Explanation: According to the truth table, the instance should be

P	Q	R	S
0	0	1	1
0	1	1	0
1	0	0	1
1	1	0	1

We see that {P, Q} and {Q,R} have unique and non-null values that can be used to identify any tuple uniquely. Hence, options (b) and (c) are correct.

Question 7

Consider the following instance of ChatBox(SenderID, ReceiverID).

SenderID	ReceiverID
104	2
22	10

If SenderID is the foreign key in the relational schema ChatMsg(ChatID, Text, SenderID), which of the following is a valid instance of ChatMsg? *Marks: 2* **MCQ**

a)

ChatID	Text	SenderID
50	ABC	104
50	MNO	22

b)

ChatID	Text	SenderID
50	ABC	104
104	MNO	22

c)

ChatID	Text	SenderID
50	NULL	50
104	MNO	22

d)

ChatID	Text	SenderID
NULL	NULL	50
104	MNO	104

Answer: (b)

Explanation: Options (a) and (d) are incorrect as ChatID is the primary key of ChatMsg and must be unique and not NULL. Option (c) is incorrect as SenderID 50 is not referencing to any tuple in the referenced relation ChatBox. Hence, option (b) is correct.

Question 8

Consider the following table:

MountainDetails		
MountainName	Altitude	StateName
Kangchenjunga	8586	Sikkim
Nanda Devi	7816	Uttarakhand
Trisul	7120	Uttarakhand
Kamet	7756	Uttarakhand
Sandakfu	3636	West Bengal
Saltoro Kangri	7742	Jammu and Kashmir
Reo Purgyill	7742	Himachal Pradesh

Identify the correct operation(s) which produces the following output from the above `relation`.

Marks: 2 **MCQ**

MountainDetails		
MountainName	Altitude	StateName
Kangchenjunga	8586	Sikkim
Nanda Devi	7816	Uttarakhand
Kamet	7756	Uttarakhand

a) $\sigma_{\texttt{(StateName='Uttarakhand')} \wedge \texttt{(Altitude>=7750)}}$ (MountainDetails)

b) $\sigma_{\texttt{(StateName='Uttarakhand')} \vee \texttt{(Altitude>=7750)}}$ (MountainDetails)

c) $\sigma_{\texttt{(StateName='Uttarakhand')}}$ (MountainDetails)

d) $\sigma_{\texttt{(Altitude>=7750)}}$ (MountainDetails)

Answer: d)
Explanation: As per `Relational Operators syntax and semantics`, option d) is correct.

Question 9

Consider the following tables:

$\texttt{MountainDetails}_1$		
MountainName	Altitude	StateName
Kangchenjunga	8586	Sikkim
Nanda Devi	7816	Uttarakhand
Sandakfu	3636	West Bengal
Saltoro Kangri	7742	Jammu and Kashmir
Reo Purgyill	7742	Himachal Pradesh

$\texttt{MountainDetails}_2$		
MountainName	Altitude	StateName
Kangchenjunga	8586	Sikkim
Trisul	7120	Uttarakhand
Kamet	7756	Uttarakhand
Sandakfu	3636	West Bengal

Identify the correct operation(s) which will be produce the following output from the above two relations. *Marks: 2* **MCQ**

MountainName	Altitude	StateName
Kangchenjunga	8586	Sikkim
Sandakfu	3636	West Bengal

a) $\texttt{MountainDetails}_1 - \texttt{MountainDetails}_2$

b) $\texttt{MountainDetails}_2 - \texttt{MountainDetails}_1$

c) $(\texttt{MountainDetails}_1 \cup \texttt{MountainDetails}_2) \cap (\texttt{MountainDetails}_1 \cap \texttt{MountainDetails}_2)$

d) $(\texttt{MountainDetails}_1 - \texttt{MountainDetails}_2) \cup (\texttt{MountainDetails}_2 - \texttt{MountainDetails}_1)$

Answer: c)
Explanation: As per Relational Operators syntax and semantics, options c) is correct.

Question 10

Which of the following can be a `candidate key` for the following instance? *Marks: 2* **MCQ**

MountainDetails		
MountainName	Altitude	StateName
Kangchenjunga	8586	Sikkim
Nanda Devi	7816	Uttarakhand
Trisul	7120	Uttarakhand
Kamet	7756	Uttarakhand
Sandakfu	3636	West Bengal
Saltoro Kangri	7742	Jammu and Kashmir
Reo Purgyill	7742	Himachal Pradesh

a) {Altitude}

b) {MountainName}

c) {StateName}

d) {MountainName, Altitude}

Answer: b)
Explanation: In the above instance, each row can be uniquely identified by using {MountainName} attribute only.
Hence, (b) is the correct option.