

TUNKU ABDUL RAHMAN UNIVERSITY OF MANAGEMENT AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATION TECHNOLOGY

ACADEMIC YEAR 2022/2023

MAY/JUNE EXAMINATION

**COMPUTER SCIENCE BACS3183**  
**ADVANCED DATABASE MANAGEMENT**

MONDAY, 29 MAY 2023

TIME: 9.00 AM – 11.00 AM (2 HOURS)

BACHELOR OF COMPUTER SCIENCE (HONOURS) IN DATA SCIENCE

BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN INTERNET  
TECHNOLOGY

BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN SOFTWARE SYSTEMS  
DEVELOPMENT

BACHELOR OF SOFTWARE ENGINEERING (HONOURS)

**Instructions to Candidates:**

Answer **ALL** questions. All questions carry equal marks.

**BACS3183 ADVANCED DATABASE MANAGEMENT****Question 1**

- a) Information can be categorised by *source, nature, level* and *time*. Explain the categorisation of information by **THREE (3) levels**. Give appropriate examples to support your answers. (9 marks)

- b) The following diagram represents the data to be stored in a Product table:

SQL> desc Product		
Name	Null?	Type
ProdID	NOT NULL	NUMBER(10)
ProdName	NOT NULL	VARCHAR2(50)
ProdDesc	NOT NULL	VARCHAR2(200)
SellingPrice	NOT NULL	NUMBER(7,2)
CostPrice	NOT NULL	NUMBER(7,2)
QuantityInStock	NOT NULL	NUMBER(5)

SQL> Note: Seller can access all attributes on Product table but Customer cannot access product ID and cost price attributes on Product table

**Diagram 1: Product Table Structure**

Explain the **THREE (3) levels** of the ANSI-SPARC architecture. Use *Database Design Language (DBDL)* and the SQL *CREATE TABLE* statement to illustrate the three levels of the ANSI-SPARC architecture design with relevant examples. (12 marks)

- c) With the aid of a diagram and an example, describe how a one-to-one relationship is modelled in an ERD (Entity Relationship Diagram) using crow's foot notation. (4 marks)

[Total: 25 marks]

Question 1 a)

### Strategic information

- It is used for long term decision making.
- For example, identify new markets and products, and plan growth.

### Tactical information

- It is a tactical planning or decision making within the guidelines set by strategic planning.
- For example, choose suppliers, forecast sales and prepare budgets.

### Operational information

- It is an operational planning based on tactical planning.
- For example, schedule employees and monitor resource usage.

Question 1 b)

### External level

- It is users' view of database.
- It describes that part of database relevant to a particular user.
- For example, the customers' view of product details

```
CREATE VIEW CustomerView AS
```

```
SELECT ProdName, ProdDesc, SellingPrice, QuantityInStock  
FROM Product;
```

### Conceptual level

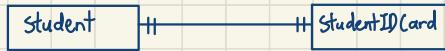
- It is community view of database.
- It describes what data is stored in database and relationship among the data.
- For example, the logical structure of the Product table.

```
CREATE TABLE Product (
    ProductID NUMBER(10) PRIMARY KEY,
    ProdName VARCHAR(50),
    ProdDesc VARCHAR(200),
    SellingPrice NUMBER(7, 2),
    CostPrice NUMBER(7, 2),
    QuantityInStock NUMBER(5)
);
```

### Internal level

- It is a physical representation of database on computer.
- It describes how the data is stored in database.
- For example, ProdID indexing and specific file formats may be involved when storing the Product table.

Question | c)



- Each student owns one and only one `StudentIDCard` and each `StudentIDCard` belongs to one and only one student.

**BACS3183 ADVANCED DATABASE MANAGEMENT****Question 2**

Given the Sunflower Puff Shop database as follows:

**Staff (StaffID, StaffName, StaffAddress, StaffContact, StaffGender, StaffDOB, StaffPosition, StaffDepartment, StaffSalary, OutletID\*)**

**Outlet (OutletID, OutletName, OutletAddress, OutletContact)**

**Puff (PuffID, PuffName, FlourUsed, SugarUsed, ButterUsed, IngredientUsed, SellingPrice)**

**Sales (SalesNo, SalesDate, PuffID\*, Quantity, StaffID\*)**

- a) Write a *relational algebra* statement for each of the following questions:
- (i) List out all female staff (ID, name, address and contact). (2 marks)
  - (ii) List out all male staff (ID, name, address and contact) who is staying at ‘Setapak Uptown’. (3 marks)
  - (iii) List out all staff (ID, name, gender and contact) who works at ‘Damansara Outlet’. (4 marks)
  - (iv) List out all Puff (ID, name and selling price) which selling price is more than or equal to RM 4.50. (2 marks)
  - (v) List out the total number of staff for each department. (2 marks)
  - (vi) List out the total number of quantity sold for each type of puff (PuffID and PuffName). (3 marks)
- b) Write the *SQL commands* to fulfill the requirements specified for the following scenarios:
- (i) All users of the database can view the outlet information, but only Julian (operation manager) can update the outlet address (OutletAddress) and contact (OutletContact). (4 marks)
  - (ii) Eric (HR manager) can do whatever he wishes to the staff information. At the same time, Eric should be able to grant the privilege to others. (3 marks)
  - (iii) Recently, Julian has resigned from the Sunflower Puff Shop, and she is no longer permitted to do anything on outlet information. (2 marks)

[Total: 25 marks]

Question 2 a)

- (i)  $\pi_{\text{StaffID}, \text{StaffName}, \text{StaffAddress}, \text{StaffContact}} (\sigma_{\text{StaffGender} = 'F'} (\text{Staff}))$
- (ii)  $\pi_{\text{StaffID}, \text{StaffName}, \text{StaffAddress}, \text{StaffContact}} (\sigma_{\text{StaffGender} = 'M'} \wedge \text{StaffAddress} \text{ LIKE } \% \text{ Setapak Uptown\%}) (\text{Staff})$
- (iii)  $\pi_{\text{StaffID}, \text{StaffName}, \text{StaffGender}, \text{StaffContact}} (\text{Staff}) \bowtie (\text{Staff}. \text{OutletID} = \text{Outlet}. \text{OutletID} \wedge \text{OutletName} = 'Pamansara Outlet') (\text{Outlet}))$
- (iv)  $\pi_{\text{PuffID}, \text{PuffName}, \text{SellingPrice}} (\sigma_{\text{SellingPrice} \geq 4.50} (\text{Puff}))$
- (v)  $\pi_{\text{StaffDepartment}} \gamma \text{COUNT StaffID} (\text{Staff})$
- (vi)  $\pi_{\text{PuffID}, \text{PuffName}} (\text{Puff}) \bowtie \text{Puff}. \text{PuffID} = \text{Sales}. \text{PuffID} \gamma \text{SUM Quantity} (\text{Sales})$

Question 2 b)

- (i) GRANT SELECT(OutletID, OutletName, OutletAddress, OutletContact) ON Outlet TO PUBLIC;  
GRANT UPDATE(OutletAddress, OutletContact) ON Outlet TO Julian;
- (ii) GRANT ALL PRIVILEGES ON Staff TO Eric WITH GRANT OPTION;
- (iii) REVOKE ALL PRIVILEGES ON Outlet FROM Julian;

**BACS3183 ADVANCED DATABASE MANAGEMENT****Question 3**

Given the CovidExamination table as follows:

PatientID	PatientName	StateID	StateName	ExamDate	VariantID	VariantName	HospitalID	HospitalName
P5010	Alice	S001	Selangor	08/01/2022	V0001	Alpha	H223	Hospital KL
P5010	Alice	S001	Selangor	08/01/2022	V0004	Delta	H223	Hospital KL
P5010	Alice	S001	Selangor	11/11/2022	V0001	Alpha	H881	Hospital PJ
P7888	Thomas	S008	Melaka	11/11/2022	V0004	Delta	H666	Hospital SB
P3002	Penny	B009	Perak	15/03/2022	V0004	Delta	H666	Hospital SB
P3002	Penny	B009	Perak	12/12/2022	V0004	Delta	H223	Hospital KL
P3355	Julie	S008	Melaka	12/12/2022	V0002	Beta	H881	Hospital PJ

**Table 1: Details of CovidExamination Table**

- a) Normalise Table 1 to a set of Third Normal Form (3NF) relations. Your answer should show all the three stages of normalisation (1NF, 2NF and 3NF) by using the Database Design Language format (underline all primary keys, composite keys and use an \* to indicate the foreign keys). State the functional dependency/dependencies that is/are removed from second and third Normal Form. Besides that, 1NF must be divided into repeating and non-repeating group relations from its original 1NF table. (16 marks)
  
- b) Based on the sample data shown in the **CovidExamination** table above, provide a specific example for insertion, modification and deletion anomalies. (9 marks)

[Total: 25 marks]

**Question 4**

- a) Based on the following set of CustomerID for the Customer table:

CustomerID	CustomerName	CustomerGender	CustomerContact
113	Michelle	F	012-1111999
118	Steven	M	013-2222888
120	Eve	F	016-3333777
127	Eric	M	017-4444666
151	Amy	F	018-5555444
159	Alice	F	019-6666333

**Table 2: Customer Table**

- (i) Construct a *B+-tree* final structure of order 3 (6 marks)
- (ii) Construct a *B+-tree* final structure of order 4 (3 marks)

Question 3 a)

INF

CovidExamination ( PatientID , PatientName, StateID, StateName, ExamDate , VariantID , VariantName, HospitalID, HospitalName )



Patient ( PatientID , PatientName, StateID, StateName )

CovidExamination ( PatientID\* , ExamDate , VariantID , VariantName, HospitalID, HospitalName )

2NF

VariantID → VariantName (Partial dependency)

Patient ( PatientID , PatientName, StateID, StateName )

Variant ( VariantID , VariantName )

CovidExamination ( PatientID\* , ExamDate , VariantID\* , HospitalID, HospitalName )

3NF

StateID → StateName ( Transitive dependency )

HospitalID → HospitalName ( Transitive dependency )

Patient ( PatientID , PatientName, StateID \* )

State ( StateID , StateName )

Variant ( VariantID , VariantName )

CovidExamination ( PatientID\* , ExamDate , VariantID\* , HospitalID\* )

Hospital ( HospitalID , HospitalName )

Question 3 b)

Insertion Anomaly :

It is not possible to add a new patient in CovidExamination table unless the patient has involved in the Covid examination event.

Modification Anomaly :

When we update the PatientName of record 'Alice' ( P5010 ) from 'Alice' to 'Alice Tan' , we will also have to update the similar PatientName value in other rows to maintain data consistency.

Deletion Anomaly :

When we delete the CovidExamination record 'Julie' ( P3355 ) from CovidExamination table , the Variant record 'Beta' ( V0002 ) will also be deleted.

Question 4 a) (i)

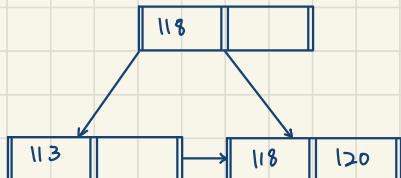
Step 1



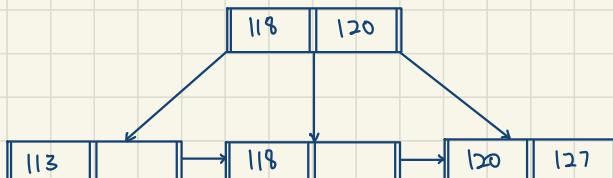
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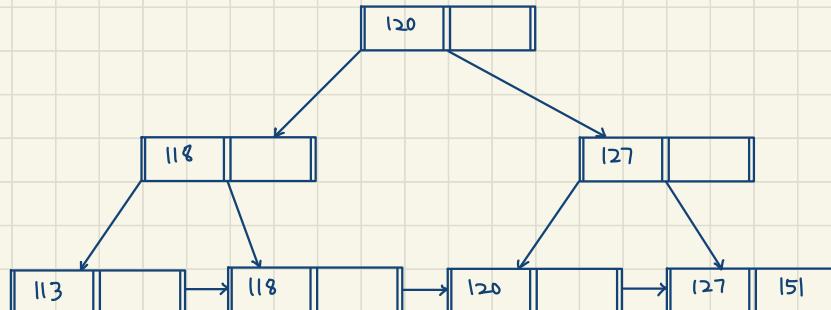
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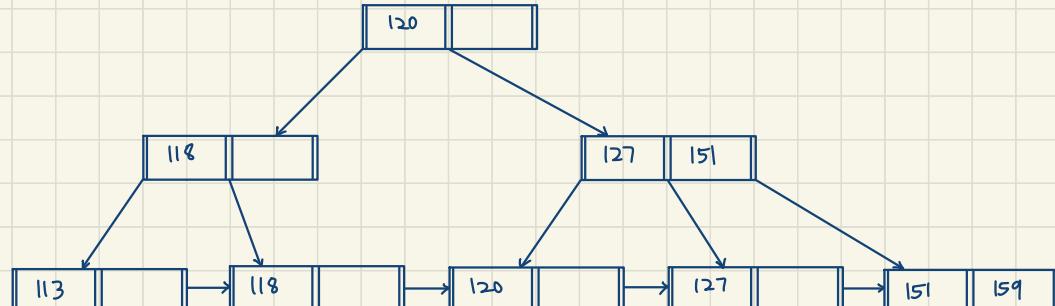
Step 4



Step 5

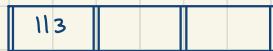


Step 6

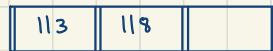


Question 4 a) (ii)

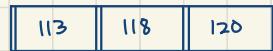
Step 1



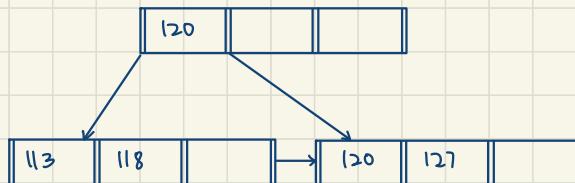
Step 2



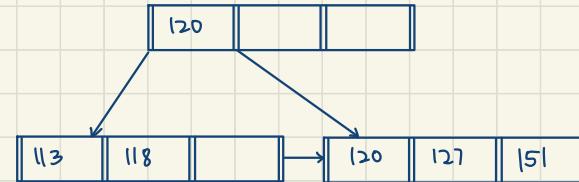
Step 3



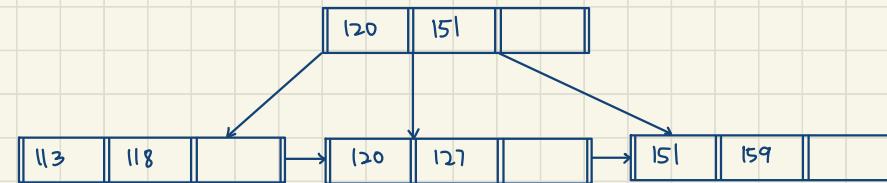
Step 4



Step 5



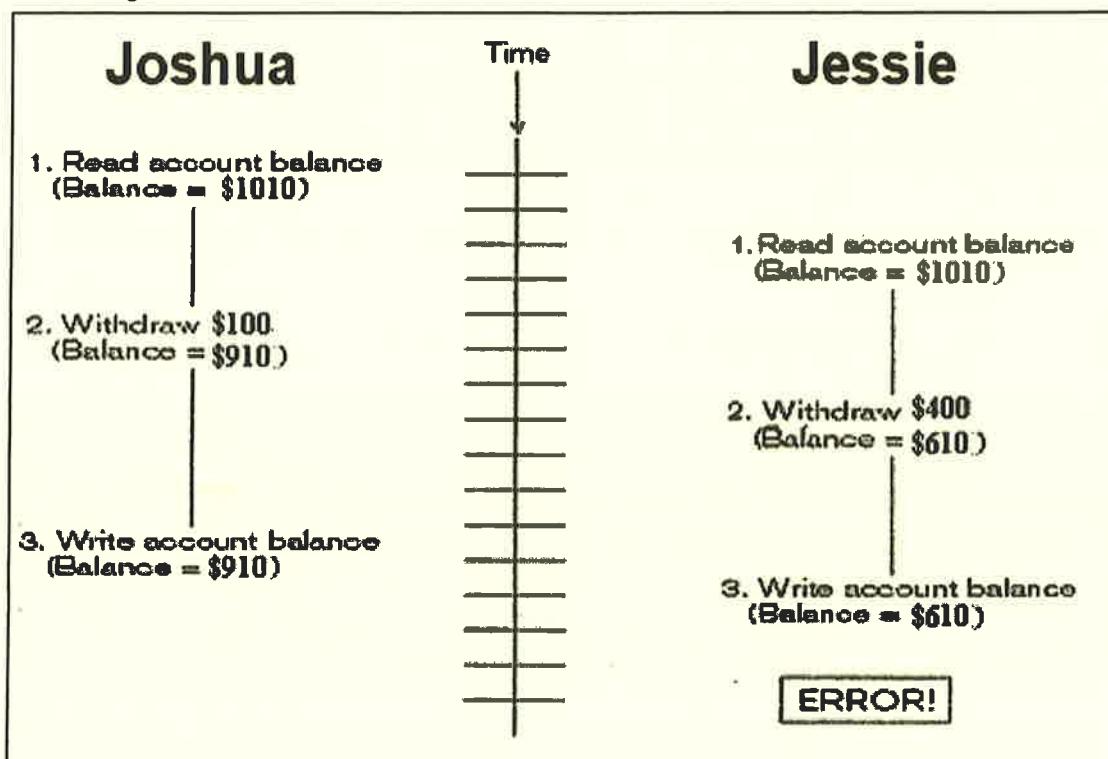
Step 6



## BACS3183 ADVANCED DATABASE MANAGEMENT

### Question 4 (Continued)

- b) In a multi-user environment, simultaneous access to the same data can result in interference and data loss. Assume that Joshua and Jessie are both accessing the same account as shown in the diagram below:



**Diagram 2: Transaction with Timeline**

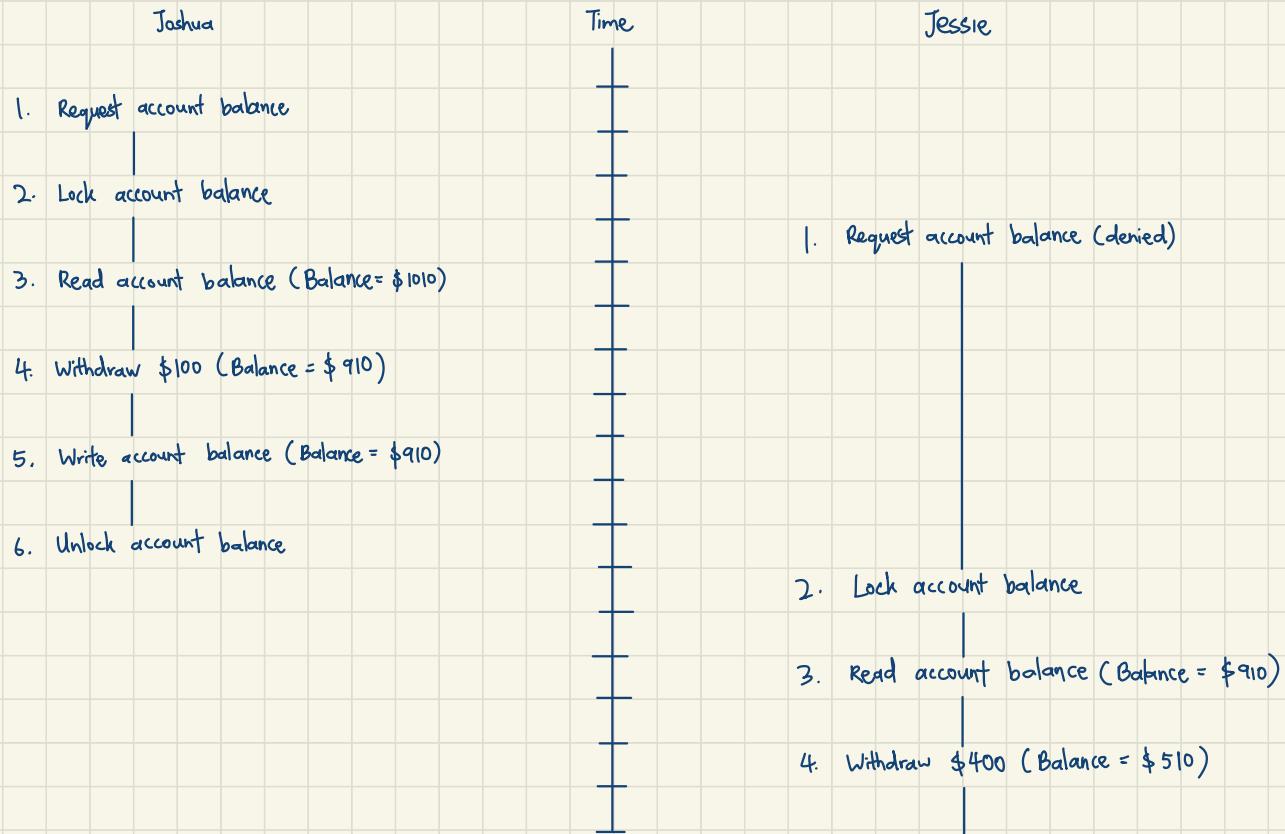
Discuss with the help of a diagram, how the above problem can be solved through:

- |                          |               |
|--------------------------|---------------|
| (i) Locking mechanism    | (4 + 4 marks) |
| (ii) Versioning approach | (4 + 4 marks) |

[Total: 25 marks]

Question 4 b) (i)

- Locking mechanism is a common way of serialization.
- When the first user is accessing or updating the data item, it will lock the data item.
- Thus, the second user will not be allowed the access the same data item until the first user has finished the transaction and unlocked the data item.



5. Write account balance (Balance = \$510)

6. Unlock account balance

Question 4 b) (i)

- Versioning approach is an optimistic approach to concurrency control
- Assumption is simultaneous updates will be infrequent.
- It allows multiple users to access and update the same data item simultaneously.
- During commit, it will check whether there is a conflict. If yes, it will rollback and restart the transaction.

