TUNKU ABDUL RAHMAN UNIVERSITY OF MANAGEMENT AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATION TECHNOLOGY

ACADEMIC YEAR 2024/2025

OCTOBER EXAMINATION

BACS3183 ADVANCED DATABASE MANAGEMENT

FRIDAY, 11 OCTOBER 2024 TIME: 3.00 PM – 5.00 PM (2 HOURS)

BACHELOR OF COMPUTER SCIENCE (HONOURS) IN DATA SCIENCE

BACHELOR OF INFORMATION SYSTEMS (HONOURS) IN ENTERPRISE INFORMATION SYSTEMS

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) Differentiate between *procedural* and *declarative* queries and provide an example for each type of queries. (5 marks)

b) Explain the **FIVE (5)** disadvantages of *traditional approach* (computer file-based system) of programming with data files. (10 marks)

c) With reference to the TAR UMT environment, illustrate and explain (using ERD, Crow's Foot notation) how the relationships between *Student*, *Programme* and *Course* entities are modelled (exclude all attributes). Many-to-many relationship need to be resolved and you must indicate the strong or weak relationship lines. (6 + 4 marks)

[Total: 25 marks]

Question 2

The *Fun Gathering Toy Shop 's* database is shown as follows:

Toy (ToyID, ToyName, ToyCategoryID*, ToyPrice, QuantityInStock, SuitableAgeGroup)
ToyCategory (ToyCategoryID, ToyCategoryName)
Customer (CustID, CustName, CustAddress, CustContact, CustGender)
Staff (StaffIC, StaffName, StaffAddress, StaffContact, StaffGender, StaffPosition, StaffSalary)
Order (OrderID, OrderDate, CustID*, StaffIC*)
OrderDetails (OrderID*, ToyID*, SellingPrice, Qty, Subtotal)

Note: customer or staff gender is either 'M' for male or 'F' for female.

a) Write a ***relational algebra*** statement for each of the following questions:

(i) List out all female customers (ID, name, address and contact) who are staying at '*Setapak Centre*'. (3 marks)

(ii) List out all cashiers (IC, name and gender) whose salary is more than or equal to RM2500. (3 marks)

(iii) List out all customers (ID, name and contact) who had made an order in February 2024 and served by staff named Edwina. (6 marks)

(iv) List out the total number of toys for each toy category (ID and name). (4 marks)

Question 1

a) Procedural queries

- It is cumbersome and prone to errors.
- Programmers must know the right sequence of instruction.
- It requires technical knowledges.
- For example,

```
SELECT book_status
INTO v_status
FROM Book
WHERE book_id = '1';

IF v_status = 1 THEN
    DBMS_OUTPUT.PUT_LINE ('The book ID 1 is active.');
END IF;
```

Declarative queries

- It requires user to state what they want to get, instead of how to get it.
- For example, `SELECT * FROM Book WHERE book_id = '1';`

b) Program-data dependence
- All programs will maintain the metadata for each file they use.

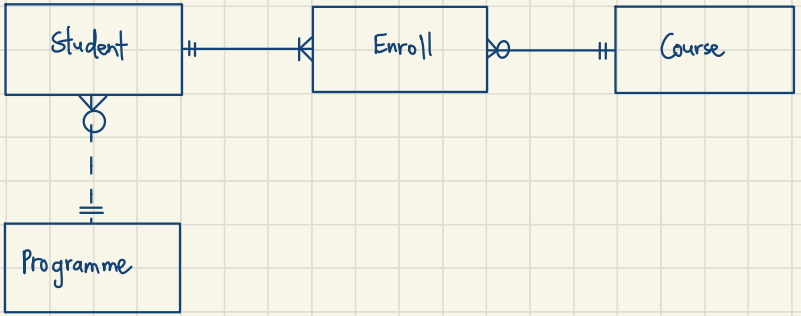
Data redundancy
- Each program or system will have separate copies of the same file.

Limited data sharing
- There is no centralized control of data.

Lengthy development time
- Programmers need to design their own file format.

Excessive program maintenance
- It requires 80% of information system budgets.

c)



- Each programme may consist of zero to many students and each student can study in one and only one programme.

- Each student can enroll for one to many courses and each course can be enrolled by zero to many students.

Question 2 a)

(i) π CustID, CustName, CustAddress, CustContact (σ CustGender = `F' $\wedge$ CustAddress LIKE `% Setapak Centre %' (Customer))

(ii) π StaffIC, StaffName, StaffGender (σ StaffPosition = `Cashier' $\wedge$ StaffSalary $\geq$ 2500 (Staff))

(iii) π CustID, CustName, CustContact (Customer) $\bowtie$ (Customer.CustID = Order.CustID (σ OrderDate $\geq$ `01/02/2024' $\wedge$ OrderDate $\leq$ `29/02/2024' (Order))) $\bowtie$ (Order.StaffIC = Staff.StaffIC (σ StaffName = `Edwina' (Staff)))

(iv) π ToyCategoryID, ToyCategoryName (ToyCategory) $\bowtie$ ToyCategory.ToyCategoryID = Toy.ToyCategoryID γ COUNT ToyID (Toy)

Question 2 (Continued)

b) Write the ***SQL commands*** to fulfil the requirements specified for the following scenarios:

	Object (Table)	Access (Yes / No)	Authorisation	User	Allow other users to access (Yes / No)	
(i)	Toy	Yes	Read on ToyID, ToyName and ToyPrice.	All Users	No	(2 marks)
(ii)	Toy	Yes	Update on ToyName and ToyPrice.	Janice	No	(2 marks)
(iii)	Toy	Yes	Can do whatever.	Francis	Yes	(3 marks)
(iv)	Toy	No	No authorisation.	Janice	No	(2 marks)

[Total: 25 marks]

Question 3

Given the **AnimalAdoption** table as follows:

ZooID	ZooName	CountryID	CountryName	AnimalID	AnimalName	CategoryID	CategoryName	AdoptionDate	CostPerUnit	Qty
Z1001	Taiping Zoo	C101	Malaysia	A1433	White Tiger	C008	Cat	08/01/2023	15000.00	2
Z1001	Taiping Zoo	C101	Malaysia	A2722	White Owl	C003	Bird	08/01/2023	3000.00	3
Z1001	Taiping Zoo	C101	Malaysia	A1433	White Tiger	C008	Cat	10/09/2024	16500.00	1
Z1008	Chiangmai Zoo	C102	Thailand	A1433	White Tiger	C008	Cat	08/03/2023	14500.00	2
Z1008	Chiangmai Zoo	C102	Thailand	A2755	Robin	C003	Bird	20/06/2023	5000.00	3
Z1100	Surabaya Zoo	C103	Indonesia	A2728	Parrot	C003	Bird	12/08/2023	7500.00	2
Z1322	Louis Mini Zoo	C104	Brunei	A2755	Robin	C003	Bird	11/11/2023	5200.00	2
Z1322	Louis Mini Zoo	C104	Brunei	A2722	White Owl	C003	Bird	23/01/2024	3200.00	2

Table 1: Details of AnimalAdoption 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 **AnimalAdoption** table above, provide a specific example for insertion, modification and deletion anomalies. (9 marks)

[Total: 25 marks]

Question 2 b)

(i) GRANT SELECT (ToyID, ToyName, ToyPrice) ON Toy TO PUBLIC;

(ii) GRANT UPDATE (ToyName, ToyPrice) ON Toy TO Janice;

(iii) GRANT ALL PRIVILEGES ON Toy TO Francis WITH GRANT OPTION;

(iv) REVOKE ALL PRIVILEGES ON Toy FROM Janice;

Question 3 a)

1NF

AnimalAdoption (ZooID , ZooName, CountryID, CountryName, AnimalID , AnimalName, CategoryID, CategoryName, AdoptionDate , CostPerUnit , Qty)

↓

Zoo (ZooID , ZooName, CountryID, CountryName)
AnimalAdoption (ZooID* , AnimalID , AnimalName, CategoryID, CategoryName , AdoptionDate, CostPerUnit, Qty)

2NF

AnimalID → AnimalName, CategoryID, CategoryName (Partial dependency)

Zoo (ZooID , ZooName, CountryID, CountryName)
Animal (AnimalID , AnimalName , CategoryID , CategoryName)
AnimalAdoption (ZooID* , AnimalID* , AdoptionDate , CostPerUnit , Qty)

3NF

CountryID → CountryName (Transitive dependency)
CategoryID → CategoryName (Transitive dependency)

Zoo (ZooID , ZooName, CountryID*)

Animal (AnimalID , AnimalName, CategoryID*)
Country (CountryID , CountryName)
Category (CategoryID , CategoryName)
AnimalAdoption (ZooID* , AnimalID* , AdoptionDate , CostPerUnit, Qty)

Question 3 b)

Insertion Anomaly:
It is not possible to insert a new record of Zoo in the AnimalAdoption table unless there is an animal adopted in the zoo.

Modification Anomaly:
When we update the ZooName of record 'Louis Mini Zoo' (Z1322) from `Louis Mini Zoo' to `Louis Zoo', we also need to update the ZooName value in other similar rows to ensure data consistency.

Deletion Anomaly:
When we delete the record `Surabaya Zoo'(Z1100) from the AnimalAdoption table, the animal record `Parrot' (A2728) will also be deleted.

Question 4

a) Based on the following set of DogID for the **Dog** table as shown in *Table 2*:

DogID	DogName	DogGender	CostPerUnit
501	Pomeranian	M	3800.00
502	Welsh Corgi	F	5800.00
503	Maltese	M	5400.00
504	American Staffordshire Terrier	M	6500.00
505	Papillion	F	5200.00
506	Cane Corso	M	4500.00

Table 2: Dog Table

(i) Construct a *B+-tree* final structure with degree of 3 (6 marks)

(ii) Construct a *B+-tree* final structure with degree of 4 (4 marks)

(iii) Construct a *B+-tree* final structure with degree of 5 (3 marks)

b) Suppose the hash function is h(x) = x mod 8 and each bucket can hold at most two records. Show the extendable hash structure after inserting 1, 12, 13, 7, 16, 2 and 4.

x	1	12	13	7	16	2	4
h(x)	001	100	101	111	000	010	100

(12 marks)

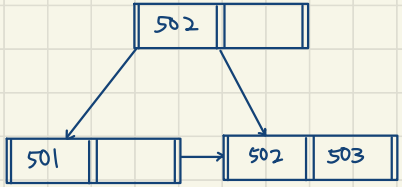
[Total: 25 marks]

Question 4 a) (i)

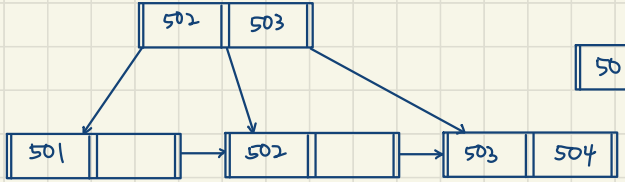
Step 1

Step 2

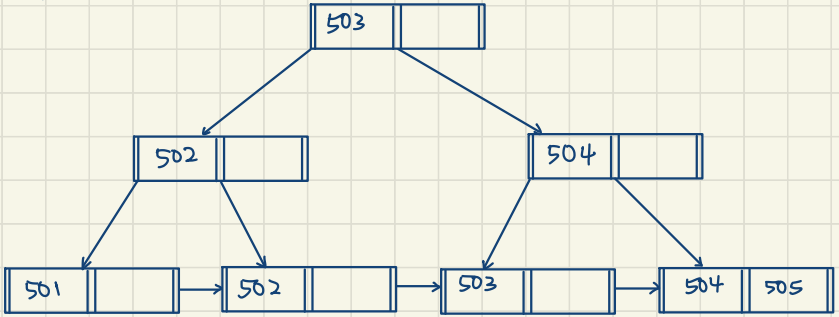
Step 3



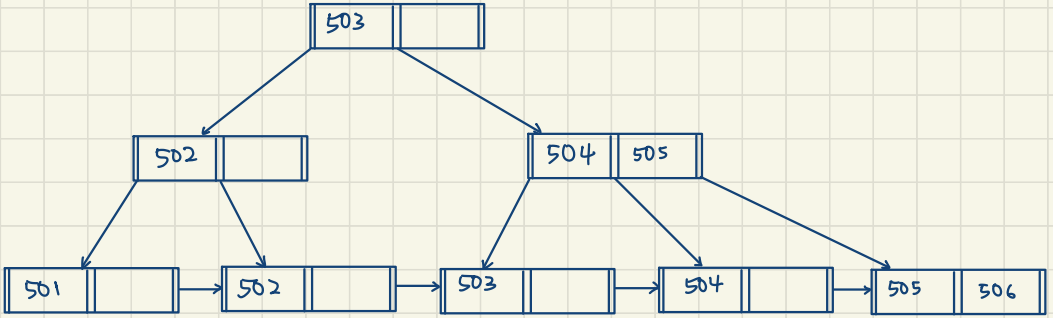
Step 4



Step 5

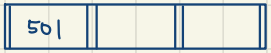


Step 6

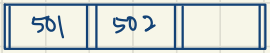


Question 4 a) (ii)

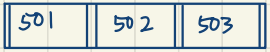
Step 1



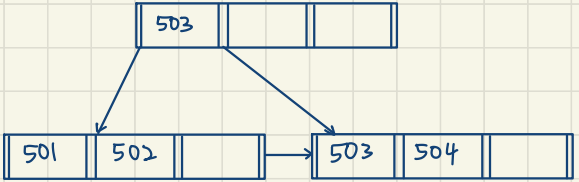
Step 2



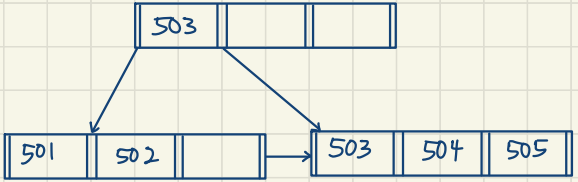
Step 3



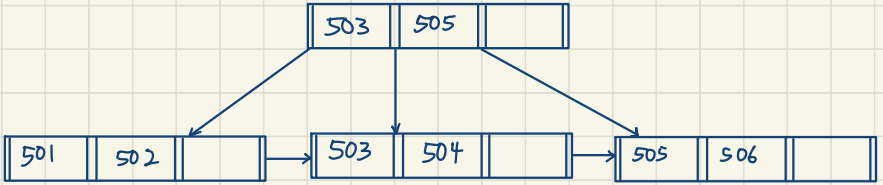
Step 4



Step 5



Step 6



Question 4 a) (iii)

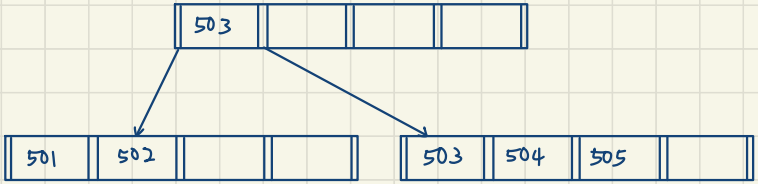
Step 1

Step 2

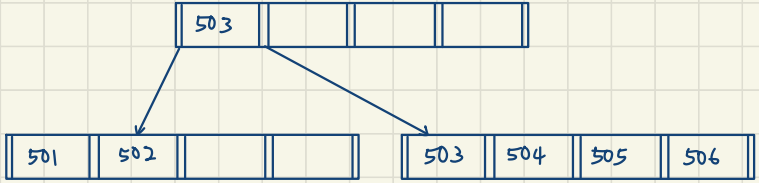
Step 3

Step 4

Step 5

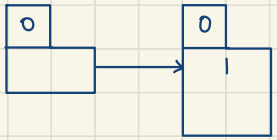


Step 6

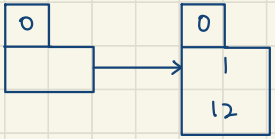


Question 4 b)

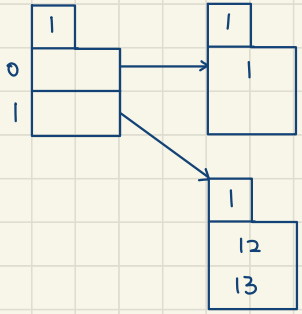
Step 1



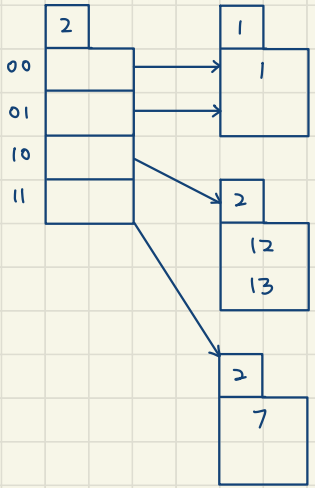
Step 2



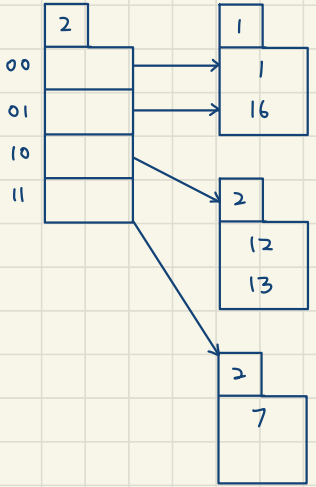
Step 3



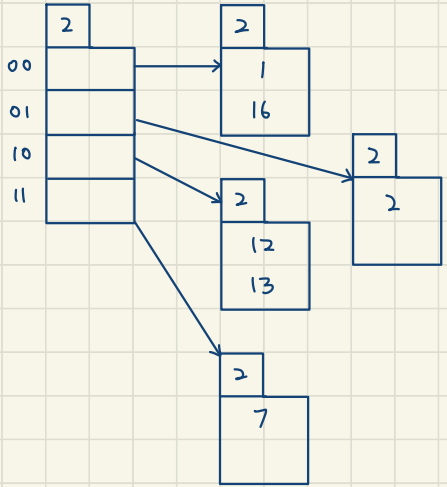
Step 4



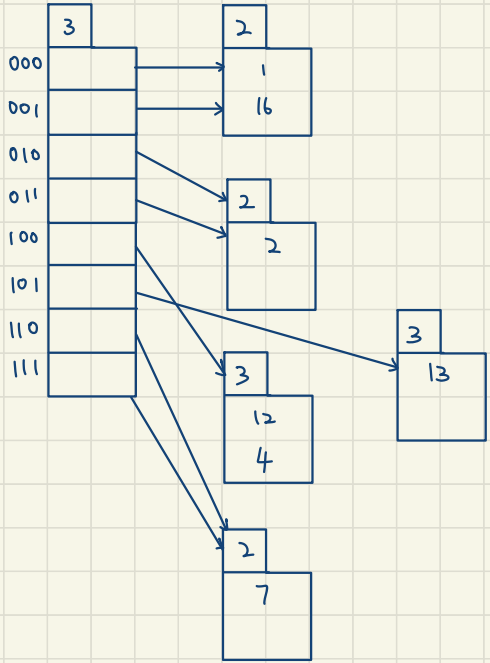
Step 5



Step 6


2
00
01
10
11
2
1
16
2
12
13
2
7
2
2

Step 7


3
000
001
010
011
100
101
110
111
2
1
16
2
2
3
13
3
12
4
2
7