UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY (EXTERNAL)

Academic Year 2022 – 3rd Year Examination – Semester 6

IT6405(R) – Database Systems II (Repeat)

Structured Question Paper

(TWO HOURS)

To be completed by the candidate

BIT Examination Index No: .....

Important Instructions:

- The duration of the paper is **2 (Two) hours**.
- The medium of instruction and questions is English.
- This paper has **4 questions** and **12 pages**.
- **Answer all questions.** All questions carry **equal** marks.
- **Write your answers** in English using the space provided **in this question paper**.
- Do not tear off any part of this answer book.
- Under no circumstances may this book, used or unused, be removed from the Examination Hall by a candidate.
- Note that questions appear on both sides of the paper.
  If a page is not printed, please inform the supervisor immediately.
- All kinds of electronic devices including programmable calculators are **not** allowed.
- Non-Programmable calculators are allowed.
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Questions Answered

Indicate by a cross (×), (e.g. [×]) the numbers of the questions answered.

	Question numbers				
To be completed by the candidate by marking a cross (×).	1	2	3	4	
To be completed by the examiners:					

Index No …….

1) (a) Write down two common uses of database triggers.

[4 marks]

ANSWER IN THIS BOX

-Provide sophisticated auditing
- Prevent invalid transactions
- Enforce referential integrity (either those actions not supported by declarative constraints or across nodes in a distributed database)
- Enforce complex business rules
- Enforce complex security authorizations
- Provide transparent event logging
- Automatically generate derived column values
- Enable building complex views that are updatable
- Track database events

Any two of the above.

(b) Write down three differences between triggers and stored procedures.

[6 marks]

ANSWER IN THIS BOX

Triggers are implicitly called by the database itself while Stored Procedure has to be manually called by the user.

Stored Procedure can pass the parameters which is not the case with Triggers.
While creating a Trigger, triggering event and action have to be specified, which is not the case with Stored Procedure.

A Trigger can call the specific Stored Procedure in it but the reverse is not true.
Any three of the above.

(C) Write the SQL query to create the Department table with the following constraints.

Department (deptID, deptName, location, deptHead, numEmployees)

- deptID is a number used as the primary key.
- deptName cannot be null
- Default location to be 'Colombo'
- deptHead specifies a unique number
- numEmployees should be a number between 1-25

[4 marks]

ANSWER IN THIS BOX

```
CREATE TABLE Department (
   deptID int  Primary Key,
   deptName  CHAR(20)/VARCHAR(20) NOT NULL,
   location CHAR(25)/VARCHAR(20) DEFAULT 'Colombo',
   deptHead INT UNIQUE,
   numEmployees INT CHECK (numEmployees BETWEEN 1 AND 25));
```

(d) Consider the following relational schema.

Product (PCode, QOH, PMin, Price, MinOrder, Reorder)

Write a statement-level trigger to execute after an update of QOH or PMin for an existing row or after an insert of a new row in the Product table. The trigger action should execute an update statement that compares QOH with the PMin column. If the value of QOH is equal to or less than PMin, the trigger should update the Reorder to 1.

[6 marks]

ANSWER IN THIS BOX

```
CREATE TRIGGER T1
AFTER INSERT OR UPDATE OF QOH, PMin ON Product
BEGIN
  UPDATE Product
     SET Reorder = 1
        WHERE QOH <= PMin;

END;
```

Note: This is a model answer. Different queries can create to generate the same result. Will consider all relevant answers.

(e) Consider the following schema to answer the given questions.

Employee (eno, ename, hireDate, salary)

Write a row-level trigger named ***display_salary_difference*** that would fire for INSERT, UPDATE or DELETE operations performed on the Employee table. This trigger should display the previous salary, new salary and the difference between the old and new salary values.

[5 marks]

ANSWER IN THIS BOX

```
CREATE OR REPLACE TRIGGER display_salary_difference
BEFORE INSERT OR UPDATE OR DELETE ON Employee
FOR EACH ROW
WHEN (NEW.empID > 0)
DECLARE sal_diff  NUMBER;
BEGIN
  Sal_diff := :NEW.Salary - :OLD.Salary;
  DBMS_OUTPUT.PUT_LINE('Previous Salary:' || : OLD.Salary);
  DBMS_OUTPUT.PUT_LINE('New Salary:' || :NEW.Salary);
  DBMS_OUTPUT.PUT_LINE('Salary Difference:' || sal_diff);

END;
```

Note: This is a model answer. Different queries can create to generate the same result. Will consider all relevant answers.

2) (a) Suppose that we have an ordered file with r = 30,000 records stored in a disk with block size B = 512 bytes. File records are of fixed size and unspanned, with record size R = 150 bytes.

(i) Calculate the blocking factor/ BFR.

[1 marks]

ANSWER IN THIS BOX

blocking factor = 512/150
= 3
Three records per block.

(ii) How many block accesses are required to search a record in the data file using the binary search?

[2 marks]

ANSWER IN THIS BOX

The number of blocks needed for the file = 30000/3
= 10000 blocks

A binary search on the data file would need log2b block accesses.
= log210000
=13.23 = 14 block accesses

(iii) Suppose that the ordering key field of the file is V = 9 bytes long, a block pointer is P = 7 bytes long, and we have constructed a primary index for the file. How many block accesses are required to search a record using the index?

[4 marks]

ANSWER IN THIS BOX

Index entry size = 9 + 7 = 16 bytes
The blocking factor for indexes is 512/16 = 32
Number of index blocks = 10000/32 = 313
To perform a binary search on the index file would need = log2b
= log2313
= 8.23 = 9

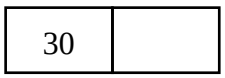
We need one additional block access to the data file for a total of 9 + 1 = 10 block accesses

b) Construct a B tree of order three and show the stages of the B tree when each of the following seven key values are inserted into it.
30, 10, 15, 12, 8, 20, 45

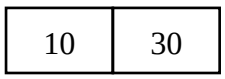
[7 marks]

ANSWER IN THIS BOX

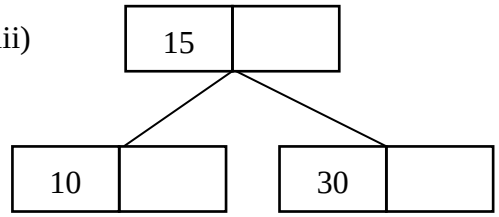
(i)



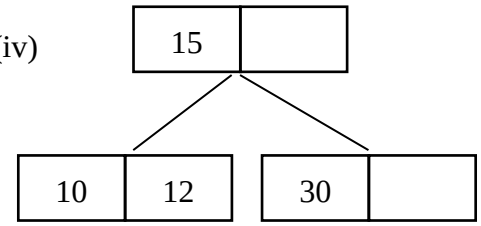
(ii)



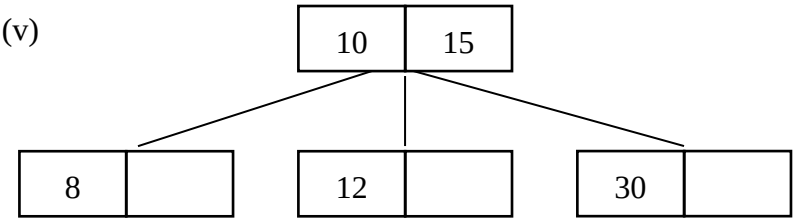
(iii)



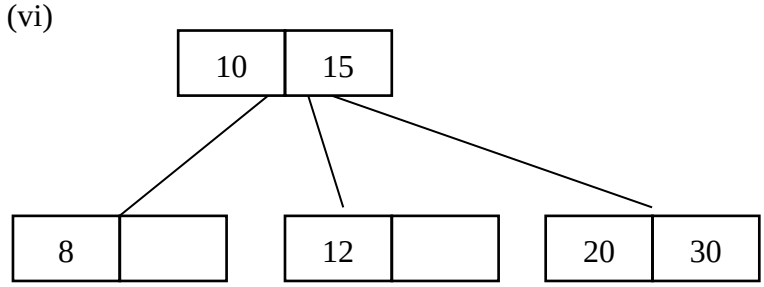
(iv)



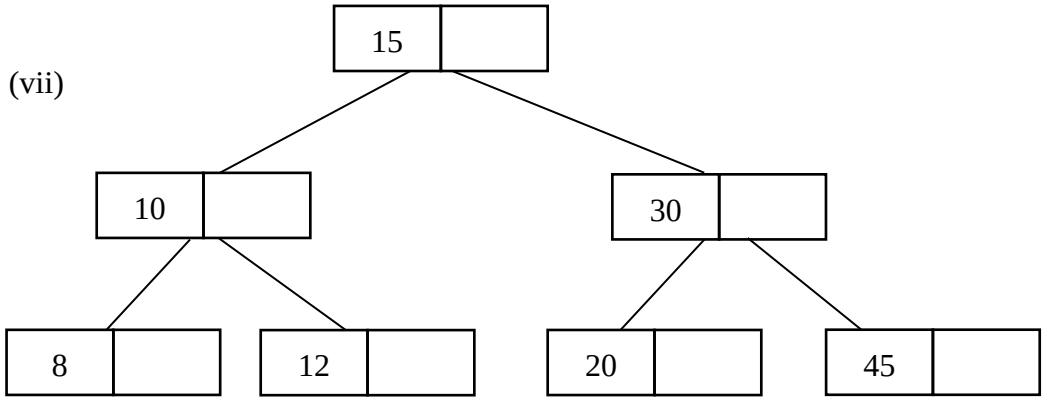
(v)



(vi)



(vii)



(c) (i) The University examinations database consists of students, courses, and results as follows.
Student (Sno, name, address, age, telephone, program, year)
Course (Cno, name, credits, lecturer)
Result (Cno, Sno, mark, grade, year)

It is necessary to retrieve names of all the students who are older than 25 years and have obtained 70 or more marks for "Advanced Database Systems" course. Describe how this query would be issued and identify all the stages of processing, this query would undergo.

[5 marks]

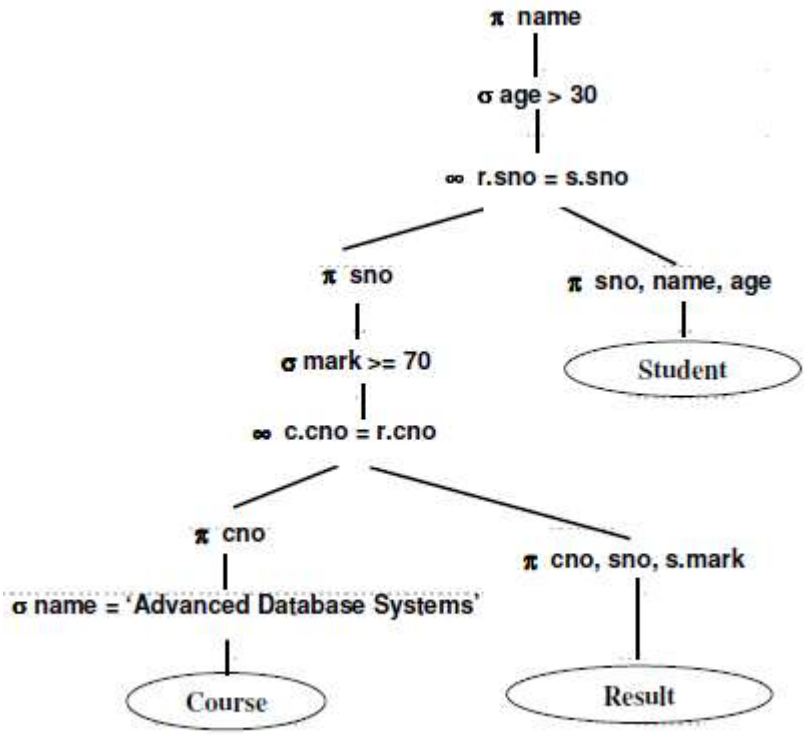
ANSWER IN THIS BOX

Express the query in a high-level language and submit it to the database
The query would be scanned, parsed, and validated by the query processor
Map the query into some intermediate form
Optimize the query using heuristics and statistics
Device and execution plan
General the query code
Run the query and produce the results

(ii) Assume that there are 100 students, 10 courses and all students have grades for each course. Half (50%) of the students are more than 25 years old. Draw the optimized query tree for the above c(i) query.

[6 marks]

ANSWER IN THIS BOX



3 (a) Concurrent executions of transactions can cause problems for the database. Briefly explain the **Lost Update problem** and **Temporary Update (Dirty Read) problem** that can occur due to the concurrent execution of transactions. Use appropriate examples to describe the two problems.

[6 marks]

ANSWER IN THIS BOX

Lost Update problem

Occurs when two different transactions are trying to update the same column on the same row within a database at the same time.

T1	T2
READ(X) X = X – N	
	READ (X) X = X + M
WRITE(X) READ(Y)	
	WRITE(X)

Temporary Update (Dirty Read) problem
Occurs when one transaction updates a database item and then the transaction fails for some reason Meanwhile.

T1	T2
READ(X) X = X – N WRITE(X)	
	READ (X) X = X + M WRITE(X)
READ(Y) ROLLBACK	

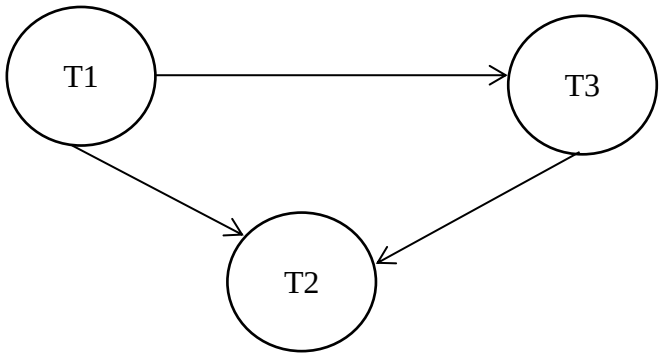
(b) (i) Consider the following schedule S, consisting of three transactions T1, T2, and T3. Note that each R and W denotes read, and write operations respectively.

T1	T2	T3
W(A)		
	R(A)	
W(B)		
		W(B)
		W(B)
	W(A)	
		R(B)
	R(B)	

Draw the precedence graph for S.

[5 marks]

ANSWER IN THIS BOX



(ii) Is S conflict serializable? Justify your answer.

[3 marks]

ANSWER IN THIS BOX

Yes. Because the graph did not contain cycles.

T1 → T3 → T2

(ii) Is S view serializable? Justify your answer.

[3 marks]

ANSWER IN THIS BOX

Yes. Since this is conflict serializable, this should be view serializable.
All the conflict serializable schedules are view serializable too.

(c) Consider that there is Enroll (Sid, Courseid, Mark) with values (123, 'SCS1203', 82), (234, 'SCS1204', 72), (345, 'SCS1203', 63). The Enroll is accessed by two transactions T1 and T2 as depicted in the following table.

T1	T2
`Set transaction isolation Level READ COMMITTED;`	
Q1: `SELECT Sid, Mark FROM Enroll WHERE Courseid = 'SCS1203';`	
	Q2: `UPDATE Enroll SET Mark= Mark + 5 WHERE Courseid = 'SCS1203';`
Q3: `SELECT Sid, Mark FROM Enroll WHERE Courseid = 'SCS1203';`	

Write down the possible query results of Q1 and Q3.

[4 marks]

ANSWER IN THIS BOX

Q1

Sid	Mark
123	82
345	63

Q3

Sid	Mark
123	82
345	63

(d) Consider a table R (A) containing {(1), (2)}, and two transactions T1 and T2.

T1: UPDATE R SET A = 2*A;
T2: SELET AVG (A) FROM R;

If transaction T2 is executed using READ UNCOMMITTED, what would be the possible return values?

[4 marks]

ANSWER IN THIS BOX

1.5, 2, 2.5, 3

4 (a) State two (02) advantages of distributed databases.

[4 marks]

ANSWER IN THIS BOX

Reflects organizational structure
Local autonomy
Improved availability
Improved performance
Modularity

(b) State two (02) disadvantages of distributed databases.

[4 marks]

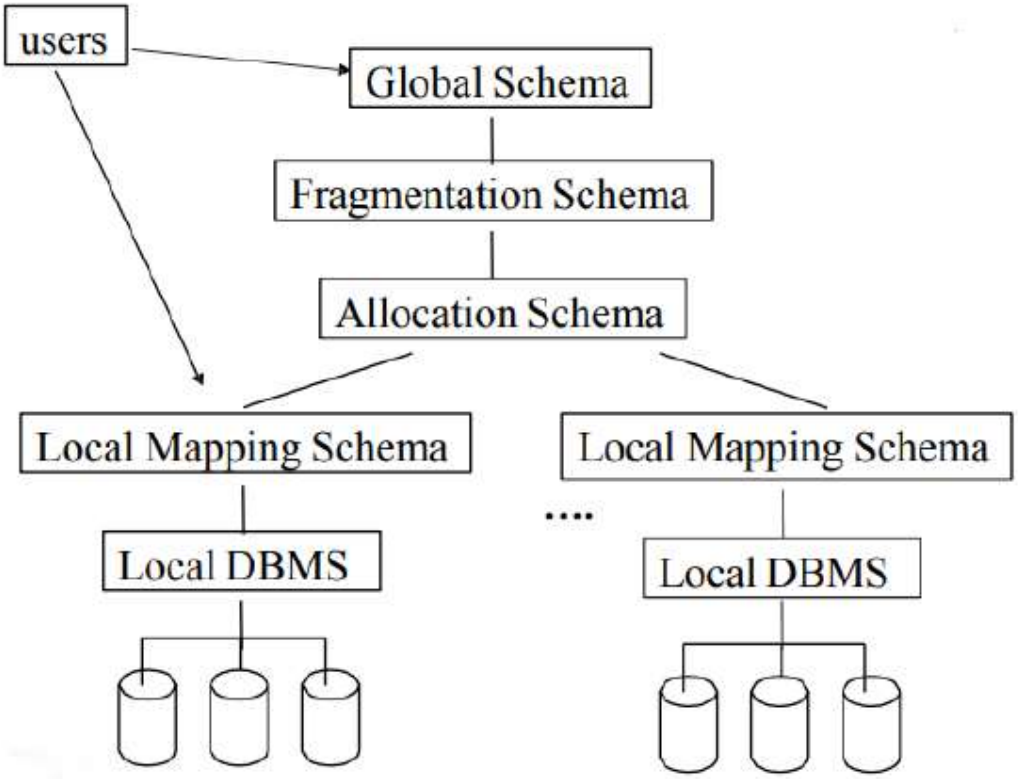
ANSWER IN THIS BOX

Complexity
Economics
Security
Difficult to maintain the integrity
Inexperience

(c) Draw the architectural diagram for a distributed database management system and identify its components.

[7 marks]

ANSWER IN THIS BOX



(d) Briefly explain the three Fragmentation types.

[6 marks]

ANSWER IN THIS BOX

Horizontal Fragmentation: Partitions the records of a global table into subsets. A horizontal fragment keeps only certain rows of the global relation.

Vertical Fragmentation: Subdivides the attributes of the global table into groups. A vertical fragment keeps only certain attributes of the global relation.

Mixed Fragmentation: Result of the successive application of both fragmentation techniques.

(e) State the basic strategies for distributing data among the sites (or nodes) of a network.

[4 marks]

ANSWER IN THIS BOX

Data Replication
Horizontal Partitioning
Vertical Partitioning
Combinations of the above

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