

Examination Information Page

Written examination

General information about the exam:

Subject code: DAT2000-1

Subject name: Databases 2

Examination date: 20.12.2024

Examination time: 09:00

Total hours: 4

Responsible course manager: Ali Chelli

Campus: Ringerike

Faculty: USN School of Business

No. of assignments: 3

No. of attachments: 0

No. of pages incl. information page and attachments: 5

Permitted aids:

None

Information regarding attachments:

None

Comments:

None

THE CANDIDATE MUST VERIFY THAT THE TASK SET IS COMPLETE ON THEIR OWN.

Problem 1 (40 Points)

1. Provide the name of the four ACID properties. **(2 points)**
2. Provide the definition of each of the ACID properties. **(8 points)**
3. Draw a precedence graph involving 3 transactions T1, T2, and T3. The precedence graph must contain a cycle. Explain how we can check that this graph contains a cycle. **(4 points)**
4. We consider the following notation: $W1(A)$ is a write operation performed by Transaction 1 on data item A. $R2(B)$ is a read operation performed by Transaction 2 on data item B. For each of the following schedules (S1, S2, and S3), draw the precedence graph; indicate if the precedence graph has a cycle or not, and conclude if the schedule is conflict serializable or not. **(9 points)**
 - a. S1: $R1(A)$, $W1(A)$, $R2(A)$, $R2(B)$, $W2(B)$, $W3(B)$, $R3(C)$, $W2(C)$
 - b. S2: $W3(D)$, $W3(A)$, $W1(D)$, $R1(B)$, $W3(B)$, $W3(E)$, $R2(E)$, $W2(E)$
 - c. S3: $R2(A)$, $W2(A)$, $W3(A)$, $R2(C)$, $W2(C)$, $W3(C)$
5. Consider the scenario shown in **Figure 1** where a system failure occurs as indicated by the vertical red dashed line. After the system restart, determine which transactions must be undone and which transaction must be redone. **(6 points)**
6. One of the main recovery techniques is Deferred Update. Provide the main characteristics of Deferred Update. **(5 points)**
7. We consider the scenario shown in **Figure 1** where a system failure occurs as indicated by the vertical red dashed line. Assuming that Deferred Update technique is applied. After the system restart, determine what should happen for each transaction. **(6 points)**

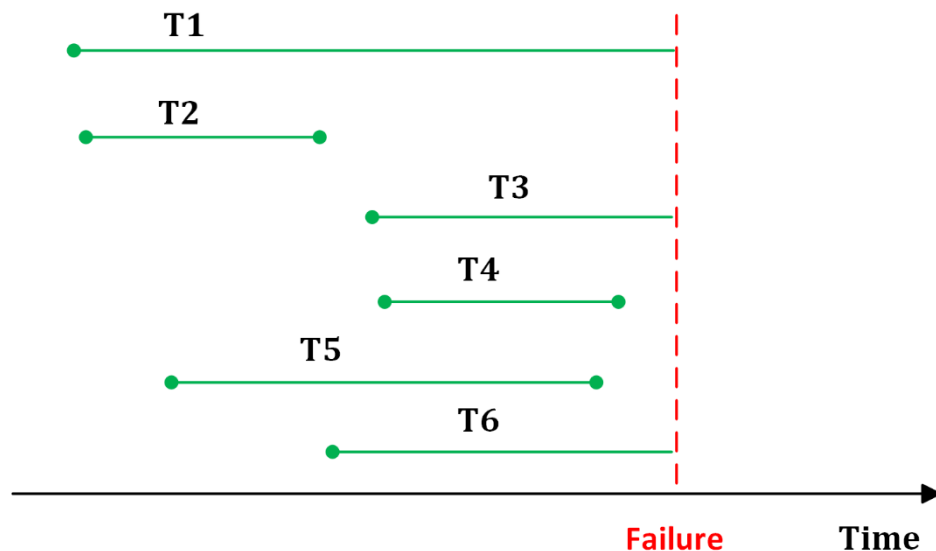


Figure 1

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Problem 2 (20 Points)

1. We consider the following canonical tree provided in Figure 2. Write down the SQL query matching with the canonical tree. Note that in Figure 2 E refers to the table Employee, while B refers to the Branch. **(4 points)**

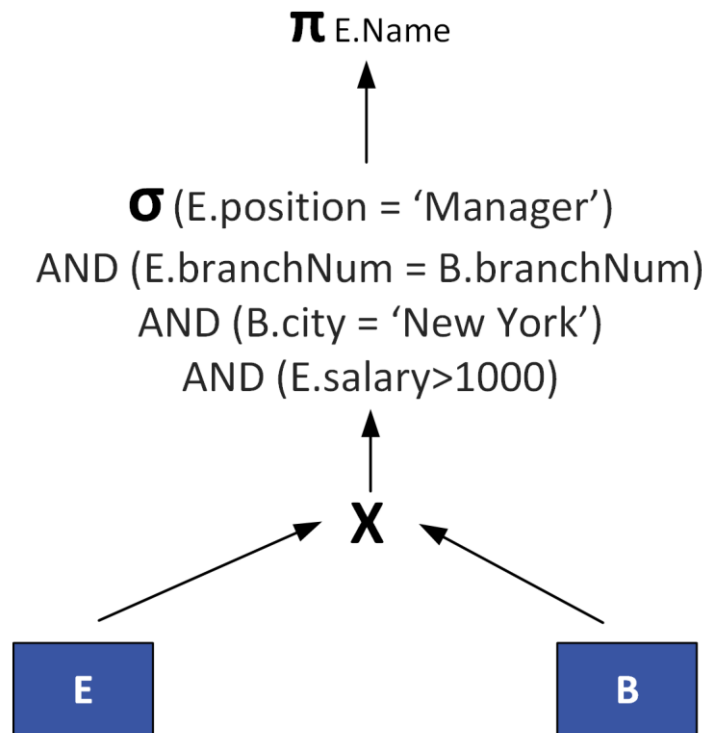


Figure 2

2. We assume that table E has 10 records and table B has 5 records. How many records would the cartesian product (E X B) would have? **(2 points)**
3. Provide a description of the steps needed to obtain an optimal query starting from the canonical tree. **(6 points)**
4. Draw the different trees corresponding to the different optimization steps including the final optimal tree. For each of the trees indicate which rule has been used to obtain it. **(8 points)**

Problem 3 (40 Points)

We consider a database for an e-commerce platform. The database has 2 tables: Products and Sales.

1. The SQL code for the Products table is

CREATE TABLE Products (

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```

product_id SERIAL PRIMARY KEY,
name VARCHAR(100) NOT NULL,
price NUMERIC(10, 2) NOT NULL,
stock INT NOT NULL);

```

Explain why the product-id type is set to serial in this context. **(3 points)**.

2. The SQL code for the Sales table is

```

CREATE TABLE Sales (
    sale_id SERIAL PRIMARY KEY,
    product_id INT REFERENCES Products(product_id),
    quantity INT NOT NULL,
    sale_amount NUMERIC(10, 2) NOT NULL,
    sale_date TIMESTAMP DEFAULT CURRENT_TIMESTAMP);

```

Explain the purpose and functionality of “`product_id INT REFERENCES Products(product_id)`” in this context? **(2 points)**

3. We consider the code of this stored procedure

```

CREATE OR REPLACE PROCEDURE add_product(
    p_name VARCHAR, p_price NUMERIC, p_stock INT)
LANGUAGE plpgsql
AS $$
DECLARE
    new_product_id INT;
BEGIN
    INSERT INTO Products (name, price, stock)
    VALUES (p_name, p_price, p_stock)
    RETURNING product_id INTO new_product_id;

    RAISE NOTICE 'Product added with ID: %', new_product_id;
END;
$$;

```

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Explain the functionality of this stored procedure. Hint: the RETURNING clause is used in SQL INSERT, UPDATE, or DELETE statements to return values based on each row affected by INSERT, UPDATE, or DELETE. **(5 points)**

4. **Create a stored procedure to record a sale:** provide the code of a procedure named record_sale that takes the following input parameters:

- p_product_id: The ID of the product being sold.
- p_quantity: The quantity sold.

The procedure should:

- Check the current stock
- If the stock is insufficient, raise an error message: "Insufficient stock for product."
- Calculate total sale amount: total_sale_amount := product_quantity * product_price;
- Update the stock in the Products table (reduce the stock by the sold quantity).
- Insert a record into the Sales table with the sale details (product ID, quantity, and total sale amount).

(20 points)

5. **Create a stored procedure to check product stock:** provide the code of a procedure named check_stock that takes the following input:

- p_product_id: The ID of the product.

The procedure should:

- Return the stock quantity of the specified product
- Display the current stock of the product using RAISE NOTICE.

(10 points)

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