

Introduction to Database Systems 2023/2024

3rd homework

1. PART (40%): Evaluation and optimization:

A schema of the ski shop information system is given:

Customer (cid, name, surname, address, telephone);
Employee (eid, name, surname, address, telephone);
Purchase (pid, sid, cid, eid, date);
Skiis (sid, brand, model, length, hardness)

Additional information is given:

|Customer| = 150 pages, 40 records/page
|Employee| = 2 pages, 40 records/page
|Purchase| = 2000 pages, 100 records/page
|Skiis| = 250 pages, 30 records/page

Buffer can store up to 2500 pages.

Let's assume that the following indices are now set on the schema from the previous task:

- Level 2 B+ index on the attribute *Purchase.date*
- Hash index on the attribute *Skiis.sid*

Our DBMS has the following algorithms to perform the join:

- Hash join
- Index nested loops join
- Sort-merge join

Translate the following SQL query into relational algebra and find the plan that reads the fewest pages or blocks:

```
SELECT Skiis.model, Skiis.length  
FROM Skiis JOIN Purchase ON (Skiis.sid = Purchase.sid)  
WHERE Skiis.brand = 'Elan' AND Purchase.date > '31.12.2023'
```

2. DEL (30 %): Transactions:

The following transaction schedule is given. A,B,C are the addresses of the records in the database and T1, T2 and T3 are the transactions.

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

- Show an example of a strict 2PL implementation that leads to a deadlock
- For a) draw a »wait-for« graph
- Avoid the previously drawn deadlock with a »wait-die« policy
- Give an example of another schedule that would be conflict-equivalent to the given schedule of transactions

3. DEL (30 %): Normalization:

Let R be a relational schema and F_R corresponding set of functional dependencies.

$$R = ABCDE$$
$$F_R = \{A \rightarrow C, B \rightarrow D, C \rightarrow A\}$$

- What normal form is the R schema in?
- Gradually normalize the scheme to 3NF, and for each new scheme, specify the keys and associated functional dependencies