Fachbereich für Computerwissenschaften

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PARIS LODRON UNIVERSITÄT SALZBURG

Datenbanken Vertiefung — Prüfung
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Name: _____ **Matrikelnummer:** _____

Hinweise

- Bitte überprüfen Sie die Vollständigkeit des Prüfungsbogens (9 nummerierte Seiten).
- Schreiben Sie Ihren Namen und Ihre Matrikelnummer auf jedes Blatt des Prüfungsbogens und geben Sie alle Blätter ab.
- Grundsätzlich sollten Sie alle Antworten auf den Prüfungsbogen schreiben.
- Sollten Sie mehr Platz für eine Antwort benötigen, bitte einen klaren Verweis neben die Frage auf die Seitennummer des zusätzlichen Blattes setzen.
- Keinen Bleistift verwenden. Keinen roten Stift verwenden.
- Verwenden Sie die Notation und die Lösungsansätze, die während der Vorlesung besprochen wurden.
- Aufgaben mit mehr als einer Lösung werden nicht bewertet.
- Als Unterlage ist ein beliebig (auch beidseitig) beschriftetes A4-Blatt erlaubt.
- Zeit für die Prüfung: 90 Minuten

Unterschrift _____

Korrekturabschnitt — Bitte frei lassen

Aufgabe	1	2	3	4	5	6	7	8	Summe
Maximale Punkte	1	1	1	1	1	1	1	1	8
Erreichte Punkte									

Exercise 1 — 1 Point

Is the following schedule **conflict serializable**? Draw a precedence graph to verify. If it is not, explain why. If it is, give an equivalent serial schedule.

T1:	T2:	T3:	T4:
		read(A)	
read(A)			
	write(C)		
read(B)			
write(A)			
			read(C)
			write(B)
	read(A)		
	write(A)		
		read(B)	

Exercise 2 — 1 Point

Answer the following questions (be concise):

1. Explain three *undesirable phenomena* of concurrent transactions.
2. What does *read uncommitted* stand for?
3. What is a *lost update* and how can it be prevented?

Exercise 3 — 1 Point

Consider the following schedule and a two-phase locking scheduler *with* lock conversions. Insert *lock*, *unlock*, and *upgrade* instructions such that all read and write operations in the schedule can be performed in this order.

```
T1:        T2:        T3:        T4:
_____________________________________

read(B)

                      read(A)

                                 read(A)

           read(A)

write(B)

           read(C)

                                 read(C)

                                 write(A)

                      write(B)
_____________________________________
```

Exercise 4 — 1 Point

Consider the **snapshot isolation** concurrency control scheme and the following transactions.

T1:	T2:
read(A)	
	read(B)
read(B)	
	read(A)
write(B)	
COMMIT	
	write(A)
	COMMIT

(a) Can `T1` and `T2` both commit? Explain why.

(b) What would using `select ... for update` change in this scenario?

Exercise 5 — 1 Point

Consider the following schedule. Indicate what happens at each step when the schedule is processed by a **multiversion timestamp-ordering** scheduler. The transactions start in order with TS(T1)=1, TS(T2)=2, TS(T3)=3, TS(T4)=4. Assume that no versions of data item `A` exist. State if a transaction must be rolled back and also consider cascading rollbacks.

T1:	T2:	T3:	T4:
`write(A)`			
	`read(A)`		
		`write(A)`	
			`read(A)`
	`write(A)`		
`write(A)`			

Exercise 6 — 1 Point

Consider the following schedule and the **two-phase locking** scheduler.

(a) Assume that all transactions want to issue a `write` operation on item `A` in the following order: `T1`, `T2`, `T3`. Complete the schedule by inserting lock requests (e.g., `R:lock-S(A)`) and granted locks (e.g., `G:lock-S(A)`) for all remaining `read` and `write` operations. Denote in the schedule if a transaction has to wait.

(b) Does the schedule result in a deadlock? Why?

(c) Briefly explain the *wound-wait* deadlock prevention scheme on this example by assuming `TS(T1)` $<$ `TS(T2)` $<$ `TS(T3)`.

```
T1:         T2:         T3:
_____________________________________
R:lock-S(A)
G:lock-S(A)
read(A)
_____________________________________


            read(A)
_____________________________________


                        read(A)
_____________________________________


_____________________________________


_____________________________________


_____________________________________
```

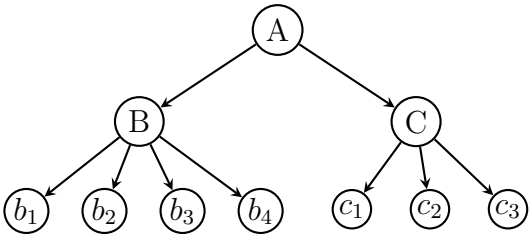
Exercise 7 — 1 Point

With the following starting values: A=10, B=20, C=30, D=40, E=50, F=60, write the log file (physical logging) for the following schedule including the log records generated during recovery. After the redo phase, which transactions are contained in the undo list?

```
T1:         T2:         T3:
start
read(A)
A:=A-5
write(A)
            start
            read(C)
read(B)
B:=B-15
write(B)
read(D)
            C:=C+20
            write(C)
                        start
                        read(E)
            COMMIT
----------CHECKPOINT------------
D:=D-20
write(D)
                        E:=E-15
                        write(E)
read(F)
                        COMMIT
F:=F-15
write(F)
------------CRASH---------------
```

Exercise 8 — 1 Point

Consider the **multiple granularity** locking scheme with intentional locks. The following figure shows a data hierarchy: for instance, the root level A is a database, B and C are relations, and b_i, c_i are data items.



Now, consider the following tasks that the transactions should execute.

- `T1`: Update a value of data item c_3.
- `T2`: Read all data items contained in B such that it is possible to update a few of them that satisfy a specific condition.
- `T3`: Read data items b_1 and c_1.

(a) Indicate the locks acquired by each of the transactions (assume that no locks are released).

(b) Which of the transactions can run concurrently, and why?