Repeatable Read   default level in MySQL

- * serializable output
- * atomic output

BUT phantom Reads

u2: T2: set Transaction isolation level repeatable read
start transaction

u1 T1: Q1; Q2 commit

Execution order by time		Output of T2	
Q1 Q2 q1 q2	T1; T2	90 60	T1; T2
q1 q2 Q1 Q2	T2; T1	100 50	T2; T1
Q1 q1 Q2 q2	nonserializable	100 50	T2; T1
Q1 q1 q2 Q2	nonserializable	100 50	T2; T1
q1 Q1 q2 Q2	non serializable	100 50	T2; T1
q1 Q1 Q2 q2	non-serializable	100 50	T2; T1

concurrent execution but serializable output.

- * no dirty Reads
- * if an item is retrieved the first time in a Tx, then the identical item is

retrieved again if the query is executed again.

- salary example: the only outputs for repeatable read are

30; 30 or 230; 230

outputs: T2; T1 T1; T2

even though execution is non-serializable.

* BUT, the same read query issued multiple times can give different outputs due to

- phantom tuples : insertions of new tuples into the table while this repeatable read TX is running.

→ SQL standard

Example:

T1: Q1: update Emp set salary = salary + 100;

Q2: insert salary = 31;

Before T1:

salary
10
20

Sum=30

After Q1

sal
110
120

Sum = 230

After Q2

sal
110
120
31

Sum = 261

T2: S1: select sum(sal) from Emp;
S2: select sum(sal) from Emp;

Execution order by time		Output of T2		
Q1 Q2 S1 S2	T1; T2	261 261	T1; T2	Serial
S1 S2 Q1 Q2	T2; T1	30 30	T2; T1	Serial
Q1 S1 S2 Q2				
S1 Q1 S2 Q2	non serializable			
Q1 S1 Q2 S2				
S1 Q1 Q2 S2				

* In all isolation levels, you can get serializable outputs.

261; 261	T1; T2
30; 30	T2; T1

I T2 runs with Read Uncommitted

Non-Serial executions	Output of T2	
Q1 S1 S2 Q2	230; 230	non-serial
S1 Q1 S2 Q2	30; 230	non-serial
Q1 S1 Q2 S2	230; 230	non-serial
S1 Q1 Q2 S2	30; 261	non-serial

Before T1:

salary
10
20

Sum=30

After Q1

sal
110
120

Sum = 230

After Q2

sal
110
120
31

Sum = 261

II T2 runs with Read Committed

Non-serial executions	Output of T2	
Q1 S1 S2 Q2	30 30	Serial T2; T1
S1 Q1 S2 Q2	30 30	
Q1 S1 Q2 S2	30 261	Non-serial
S1 Q1 Q2 S2	30 261	

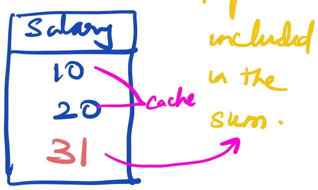
III T2 runs with Repeatable Read

(MySQL does not show phantom tuples when T2 only has Read queries)

Non-serial executions	Output of T2	
Q1 S1 S2 Q2	30 30	Serializable T2; T1
S1 Q1 S2 Q2	30 30	
Q1 S1 Q2 S2	30 30	
S1 Q1 Q2 S2	30 30	

T2 runs with Repeatable Read : SQL standard

Non-serial executions	Output of T2	
Q1 S1 S2 Q2	30 30	
S1 Q1 S2 Q2	30 30	
Q1 S1 Q2 , S2	30 61	nonserializable
S1 Q1 Q2 , S2 commit	30 61	



phantom tuples included in the sum.

Before T1:

salary
10
20

Sum=30

After Q1

sal
110
120

Sum = 230

After Q2

sal
110
120
31

Sum = 261

This table loaded into cache

IV T2 runs with serializable

* In all other isolation levels, transactions can run concurrently (non-serializable) (execute)

* BUT with serializable isolation level, execution order must be serializable.

user1

T1: Q1: update Emp ......

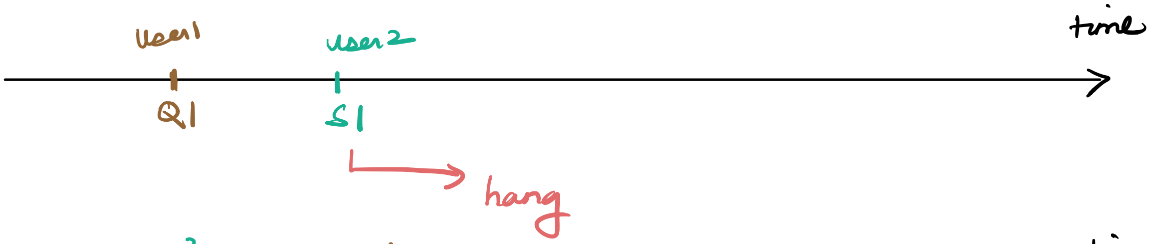
Q2: commit

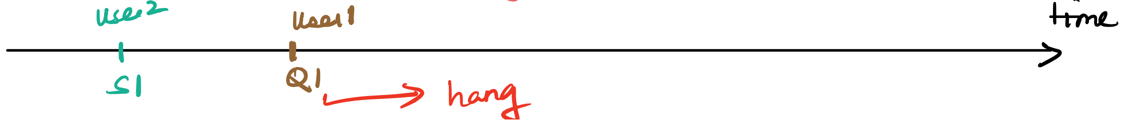
user2

T2: isolation level serializable

S1 : select * from Emp

S2: commit


user1
user2
time
Q1
S1
hang


user2
user1
time
S1
Q1
hang