

## Final Exam for Distributed Database Systems (2012)

1. (20 marks) Suppose we have three transactions T1, T2 and T3 scheduled by the locking based method as follows:

	T1	T2	T3
(1)	R1(x)		
(2)			R3(y)
(3)			W3(y)
(4)	R1(y)		
(5)			W3(x)
(6)		R2(y)	
(7)			C3
(8)	W1(x)		
(9)		R2(x)	
(10)		W2(x)	
(11)	C1		
(12)		C2	

- (i) Tell if this schedule is serializable or non-serializable and give your explanation.

答案：不可串行化。考察 T1, T3 得到以下执行顺序 (R1(x), (W3(x))), 同时还有 (W3(y), R1(y)), 前者说明 T1 领先 T3, 后者说明 T3 领先 T1。因此, 无法找到与之冲突等价的串行执行计划。

- (ii) If in the schedule W3(x) of T3 is changed into R3(x), is this changed schedule serializable or non-serializable? Why?

答案：可串行化, 等价于 (T3, T1, T2)。

2. (20 marks) Transactions T1 and T2 have following schedule in a database

	T1	T2
(1)	R1(x)	
(2)	R1(y)	
(3)		R2(y)
(4)	W1(x)	
(5)		R2(z)
(6)	C1	
(7)		W2(y)
(8)		C2

Suppose the interaction between the Local Recovery Manager and the Buffer Manager is No-Fix/Flush, tell what actions should be taken for T1 and T2 in following cases when the database system restarts

(i) The database system fails at step (4) after executing W1(x).

答案: T1, T2 均未提交, 处于执行中。当数据库系统重启时, 需要对于它们已执行的数据库操作完成 undo。T1 需要 undo W1(x), 但 T2 只有读操作, 因此无需 undo。

(ii) The database system fails at step (7) after executing W2(y).

答案: T1 已提交, T2 正在执行。当数据库系统重启时, T1 需要 redo 已经提交的更新, 但系统采取的是 flush 策略, 所有更新已在 commit 是写入磁盘, 因此无需做 redo。T2 需要 undo W2(y)。

3. (20 marks) In a distributed transaction commit following 3PC protocol, three sites -- one coordinator C and two participant sites P1 and P2, are involved. To commit a transaction T, C first sends the PREPARE message to P1 and P2, and both P1 and P2 reply to C by a VOTE-COMMIT message. So C decides to globally commit T and sends a PREPARE-TO-COMMIT message to P1 and P2. However, C fails after sending the message to P1 but before sending the message to P2 while P1 and P2 work normally.

(i) Tell what status that P1 and P2 would remain when C fails as indicated.

答案: P1 pre-commit 状态, P2 ready 状态。

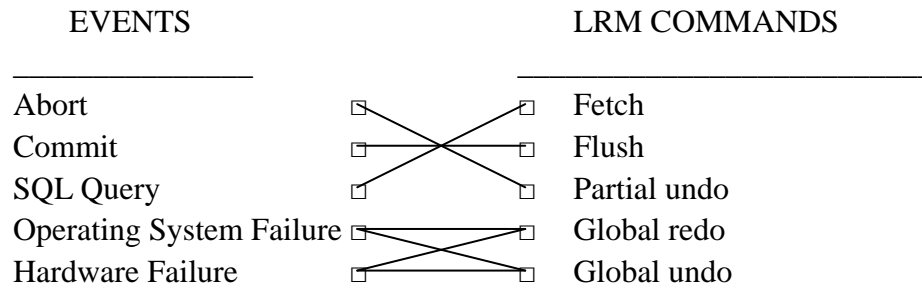
(ii) For transaction T, what actions should be taken for P1 and P2 to terminate and what actions should be taken for C to recover?

答案: 对于 P1, P2 他们可以重新选举一个新的 coordinator。如果选中了 P1, 则决定全局提交 T; 如果选中了 P2, 则全局取消 T。按照以上选举结果, P1、P2 完成各自的剩余的 3PC 操作。对于 C, 当恢复时, 要发送消息到 P1、P2 询问 T 的最终结果, 并按照这一结果完成剩余的 3PC 操作。

4. (20 marks) In the following diagram, the left column shows a list of events which are either from user or from system failures, and the right column shows a list of actions taken by LRM (Local Recovery Manager) to deal with such events; connect the box of every event in the left column with the box of corresponding command for dealing with it in the right column.

EVENTS		LRM COMMANDS
Abort	<input type="checkbox"/>	<input type="checkbox"/> Fetch
Commit	<input type="checkbox"/>	<input type="checkbox"/> Flush
SQL Query	<input type="checkbox"/>	<input type="checkbox"/> Partial undo
Operating System Failure	<input type="checkbox"/>	<input type="checkbox"/> Global redo
Hardware Failure	<input type="checkbox"/>	<input type="checkbox"/> Global undo

Answer:



5. (20 marks) We are now in a Big Data Era, where data possesses high volume, velocity (streaming), variety, and uncertainty characteristics and multiple users concurrently access databases.
- (i) Which kinds of data management technologies do you think important in dealing with Big Data?
  - (ii) Can you identify a specific technique developed by the traditional database field which is not applicable any more or needs some further improvement?

