Weekly exercises IN3020&4020 (2026)
Week 11: Recovery Protocols

1 Review

1. What do we mean by recovery and why would we want to recover?
2. Discuss at least two types of failures, one where disk is significantly damaged and one where it is not.
3. What is do we mean by a catastrophic failure? How can we recover from catastrophic failures?
4. What is database cache and what are the main buffer replacement policies?
5. How is the system log stored? What is it used for? What are its main entries?
6. What is and why do we need write-ahead logging?
7. What do we mean by checkpoints for recovery and why are they needed?
8. What is the difference between a basic (rigid) checkpoint and fuzzy checkpoints?
9. Describe the idea of the shadow recovery protocol. Discuss advantages and disadvantages of this protocol.
10. Describe the deferred-update recovery protocol. Discuss advantages and disadvantages of this protocol.
11. Describe the immediate-update recovery protocol. Discuss advantages and disadvantages of this protocol.
12. What are the main ideas of the ARIES recovery protocol? Discuss its advantages and disadvantages.

2 Recovery protocols

1. Consider the following log of two transactions, T_1 and T_2, with undo/redo entries in the form

   [Action, Transaction, DataItem, UndoValue, RedoValue]

   and rigid checkpoints:

[checkpoint]
[begin, T_1]
[write, $T_1, X, 10, 11$]
[begin, T_2]
[write, $T_2, Y, 20, 21$]
[write, $T_1, Z, 30, 31$]
[write, $T_2, U, 40, 41$]
[commit, T_2]
[write, $T_1, V, 50, 51$]
[commit, T_1]

   Describe the action of the recovery manager under the immediate-update protocol if there is a crash and the last log record to appear on the disk is

   (a) [begin, T_2]

   (b) [commit, T_2]

   (c) [commit, T_1]

2. (*) For each of the following recovery protocols, discuss how the log must look like and discuss what the system would have to do to recover after the system crash in the schedule in Table 1 (you may write *NewValue* and *OldValue* instead of the non-given concrete values):

   (a) A deferred-update recovery protocol

   (b) An immediate-update recovery protocol

3. Assume a single-user environment and a shadowing recovery protocol. Describe how the log should be like and how this system can recover from a system crash.

4. Let us consider the ARIES recovery protocol. Which log entries does it undo in the corresponding step? In particular, does it need to look before the checkpoint?

Table 1: Schedule

T_1	T_2	T_3	T_4
$\mathtt{b}_1$			
$\mathtt{r}_1(X)$			
$\mathtt{w}_1(X)$			
	$\mathtt{b}_2$		
	$\mathtt{r}_2(Y)$		
	$\mathtt{r}_2(Z)$		
	$\mathtt{w}_2(Y)$		
$\mathtt{c}_1$			
Checkpoint t_1			
		$\mathtt{b}_3$	
		$\mathtt{r}_3(U)$	
			$\mathtt{s}_4$
			$\mathtt{r}_4(V)$
			$\mathtt{w}_4(W)$
	$\mathtt{c}_2$		
		$\mathtt{c}_3$	
System crash t_2			