

Reliability Management

This module guarantees two important properties in order to preserve DB correctness and contains:

- . atomicity;
- . durability.

Primitives who can recover failures can be:

- . warm restart for main memory failures;
- . cold restart.

Log files contains all history of changes done over the database: in this way it is possible to recover errors. Log files are persistent archives and they are stored on stable memory.

Stable memory can not be realized in real but can be approximated with data redundancy and protocols. The stable memory is very robust to errors and if any of them occur, is considered catastrophic. For example, if a log file is lost there are no ways to restore a previous correct state of the database.

Log records are divided in two classes:

- . transaction records;
- . system records.

Transaction records describe the activities performed by a transaction in execution order; possible delimiters for a transaction T are:

- . $B(T)$: begin;
- . $C(T)$: commit;
- . $A(T)$: abort (rollback).

Data can be modified by these operations:

- . insert $I(T, O, AS)$;
- . delete $D(T, O, BS)$;
- . update $U(T, O, AS, BS)$.

where:

- . O is the object currently written;

- . *AS*: after state (the current state of the object after modification);
- . *BS*: before state (the state of the object before modification).

System records are data saved on disk; they can be:

- . dump;
- . checkpoint.

Checkpoint are operations done periodically otherwise a lot of transaction must be considered: it allows a faster recovery process. During the checkpoint the DBMS write data on disk synchronously for all transaction already performed.

Undo and Redo operations

This operations restore a previous correct state of the database. The following table show how operation have to be done.

ACTION	UNDO	REDO
Insert <i>I</i>	delete	write after state
Update <i>U</i>	write before state	write after state
Delete <i>D</i>	write before state	delete

Idempotency property is guaranteed:

$$\mathbf{Undo}(\mathbf{Undo}(\text{operation})) = \mathbf{Undo}(\text{operation})$$

This is done in order to guarantee possibles recover of failures occure during a recovery procedure.