

## 20 – Database Logging Schemes

### 1. Failure Classification

#### A. Txn Failure

- i. Logical Errors : txn fails because of internal error (constraint violation)
- ii. Internal State Errors : DBMS kills txn because of error (deadlock, etc)

#### B. System Failure

- i. Software Failure : bug of DBMS itself
- ii. Hardware Failure : computer crash (power cut, etc)

#### C. Storage Media Failure

- i. Non-Repairable Hardware Failure :  
some kind of destruction of hardware  
should be recovered from archived version of DB

### 2. Buffer Pool Policies

#### A. Undo vs. Redo

- i. Undo : remove changes occurred by txn (aborted or incomplete)
- ii. Redo : re-instating changes occurred by txn (committed)

#### B. Steal policy : allow/disallow writing changes of object by uncommitted txn

- i. No steal : undo is useless
- ii. Steal : need undo operation

#### C. Force policy : force/not force writing changes of object when txn commits

- i. Force : redo is useless
- ii. No Force : need redo operation

### 3. Shadow Paging

#### A. Make two separate copies of DB

- i. Master : newest version which contains changes by all committed txn
- ii. Shadow : version which contains changes by uncommitted txn also

#### B. Read only txn access the current master page table

#### C. Write txn access shadow pages and updates it

#### D. If txn commit, shadow page table becomes master table

#### E. Policies

- i. No Steal, Force
- ii. Undo : remove shadow pages / Redo : useless

#### F. Disadvantage

- i. Copying page table is expensive
- ii. Commit overhead is expensive : flush all updated page and page table, need garbage collection, etc...

#### 4. Write-Ahead Log

A. Maintain log file, which contains the changes that txns make to database.  
log should be stable storage,  
and should contain enough information for recovery

B. Log information

- i. Transaction id
- ii. Object id
- iii. Before value
- iv. After value

C. Implementation

- i. Log flushes when txn commits
- ii. Dirty records flushes when buffer pages evicted  
other policies are also possible (when txn committed or update occurs)

#### 5. Logging Schemes

A. Physical logging

- i. Just record changes of DB itself

B. Logical logging

- i. Record operation by txn itself
- ii. Recovery might be hard if concurrent txn occurs

C. Physiological logging

- i. Hybrid of physical and logical logging

#### 6. Checkpoints

A. Log will grow infinitely

B. If log file is too long, it is very hard to recover the DB

C. Periodically, flush all buffer, and write "checkpoint" to log file