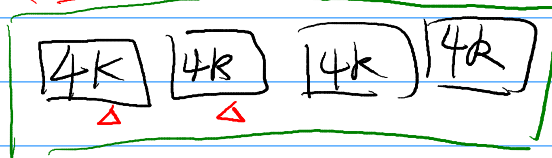UndoLog ① 页 (page) < RSEG_ARRAY
                       SYS （回滚段）
                       UNDOLOG   UndoRecord
                                  Insert   update
         ② 事务 Begin ... commit
                        rollback

RedoLog ① crash recovery

        ② mini-transaction 事务 B
           [R₁] [R₂] ... [Rₙ]
              ⌣ mtr   ⟹ MUTTL-END

UndoLog   16K
           [4K] [4R] [4k] [4R]

RedoLog (512 字节) ← sector扇区
         60
             block
             [ ]
             [I+N]   翠肇

         1/2/3   O   5+ rgtah.1, oLog₂ (41)
         50   oLog(3, 信息)
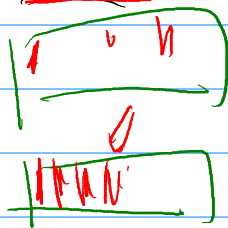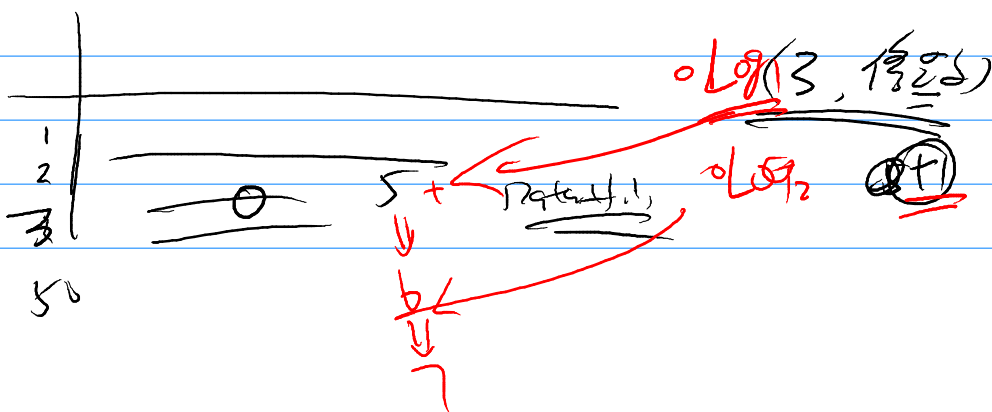   b
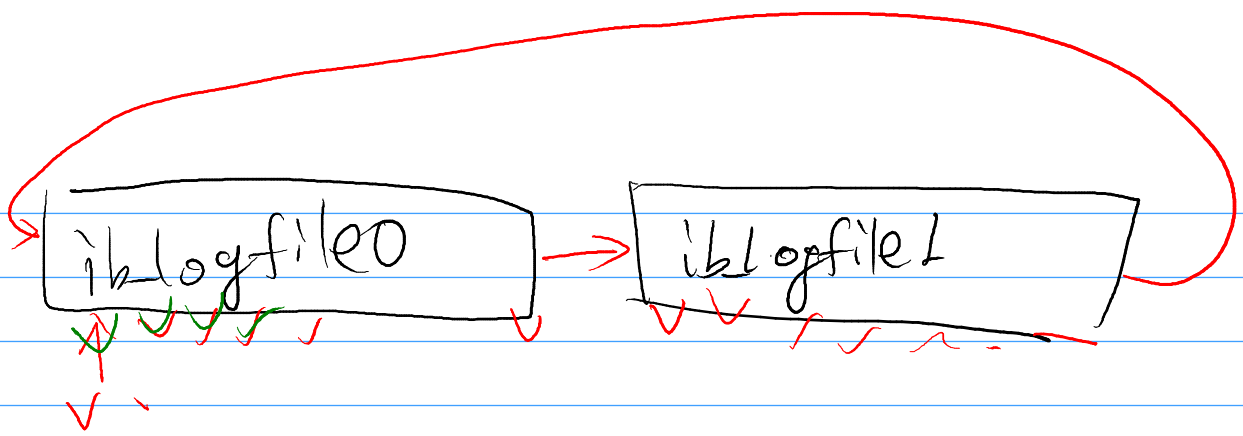   7

```
LogBlock {
    addr: 0x0000@(0),
    block_no: 1211,
    hdr_no: 7625256,
    flush_flag: false,
    data_len: 512,
    first_rec_offset: 16,
    epoch_no: 1,
    guessed_lsn: 0x00000000e8b44e00(3904130560),
    log_record: Some(
        LogRecord {
            addr: 0x0010@(16),
            log_rec_hdr: LogRecordHeader {
                addr: 0x0010@(16),
                single_rec_flag: T,
                log_rec_type: MLOG_REC_UPDATE_IN_PLACE,
                space_id: DictSpace,
                page_no: 12,
            },
            redo_rec_data: RecUpdateInPlace(
                RedoRecForRecordUpdateInPlace {
                    addr: 0x0014@(20),
                    index_info: RedoLogIndexInfo {
                        addr: 0x0014@(20),
                        index_log_version: 1,
                        index_flags: [COMPACT],
                        index_flags_byte: 1,
                        n: 8,
                        n_uniq: 1,
                        inst_cols: 0,
                        index_fields: [(8, Null, Fixed), (6, Null, Fixed), (7, Null, Fixed), (0, Null, NotFixed)
                    },
                    mode_flags: [NO_LOCKING_FLAG],
                    trx_id_pos: 1,
                    roll_ptr: RollPtr { value: 0x02000016c81138, insert: F, rseg_id: UndoSpace(2), page_no: 5832
                    trx_id: 5804291,
                    offset: 1589,
                    info_bits: 0,
                    n_fields: 0,
                    upd_fields: [],
                },
            ),
        },
    ),
    checksum: 0x740f7cd5(1947172053),
}
mysql-home-8.0.37/data »
```

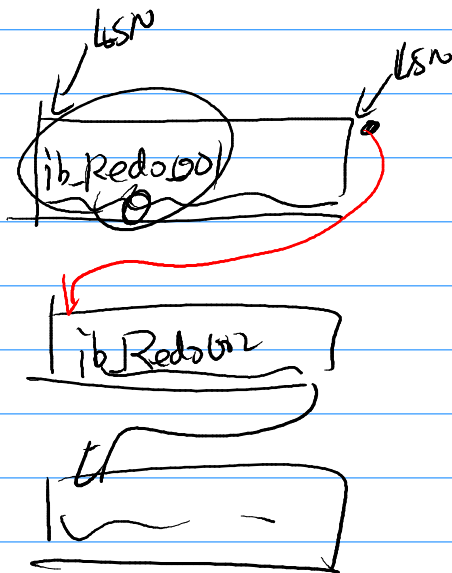ib_log_file0 → ib_logfile1

```
fil_hdr: FilePageHeader {
    addr: 0x0000@(0),
    check_sum: 0x90c9429d(2429108893),
    page_no: 12,
    prev_page: 0x0000000b(11),
    next_page: 0x0000000d(13),
    lsn: 0x00000000b2f136ba(3002152634),
    page_type: INDEX,
    flush_lsn: 0x0000000000000000(0),
    space_id: 88,
},
```

Stall

LSN   LSN

ib_Redo001

ib_Redo012

ib_Redo1191
Log File
Log