# Isolation level : Serializability : 2PL.
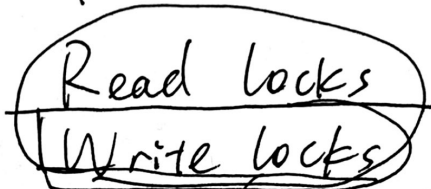
1° Grab Locks ; Access item; Grab ----

2• (Merge ~~write buffers~~) : Release Locks. Dynamic

$\left(\boxed{\text{Read Locks}}\atop\boxed{\text{Write Locks}}\right)$

Performance $\longleftarrow$ $\longrightarrow$ Correctness.

db. start_tx ( )
db. exec ( SQL1 )
db. exec ( SQL2 )
db. commit_tx ( )
db. abort ( )

$\begin{cases} \underline{corrupted} - \\ \underline{uncommitted} \end{cases}$ $\overset{\underline{cas}}{\diagup}$

## Dirty Read.

$a = 0$

Tx 1  $\underline{W(a) = 1}$

Tx 2.  $R(a) = 1$

$\underline{\text{undo log}}$

Abort.

ww $\overset{T_1}{\underset{T_2}{\times}}$ ww
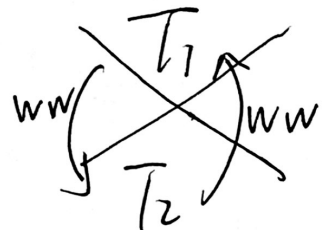
## Non-Repeatable / Fuzzy Read.

Tx1 :  $R(a) = 0$

Tx2

read-write
$\underline{rw}$
$\downarrow$
Write (a) = 1

$\begin{cases} ww \\ wr \\ rw \end{cases}$

$R(a) = 1$

$\uparrow$ wr

c

rw $\overset{Tx1}{\underset{Tx2}{\diagdown}}$ wr

∉A .
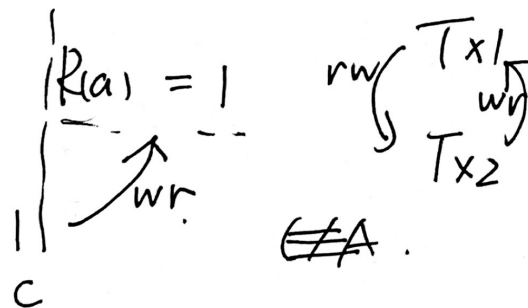
$$\xrightarrow{\hspace{5cm}} \text{timestamp.}$$
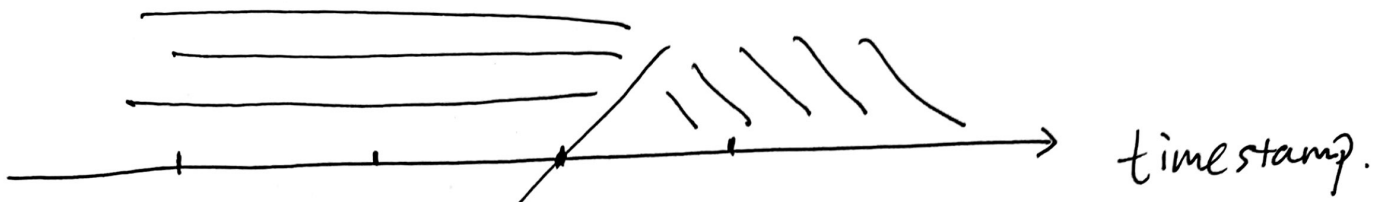
starts $\begin{cases} \text{read timestamp. (inc it.)} \\ \underline{\text{read}} \quad V_r \leqslant \text{timestamp.} \\ \text{write} \quad V_w \leftarrow \text{timstamp.} \\ \text{lock\_} \underline{w}. \\ \text{commit.} \end{cases}$
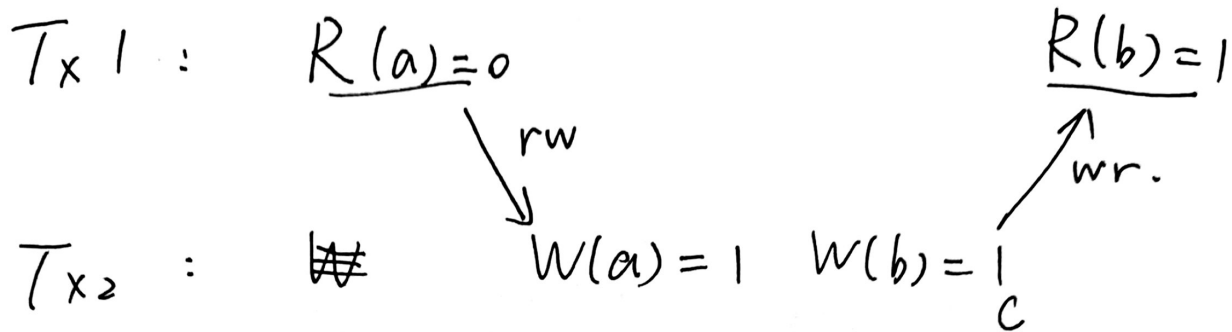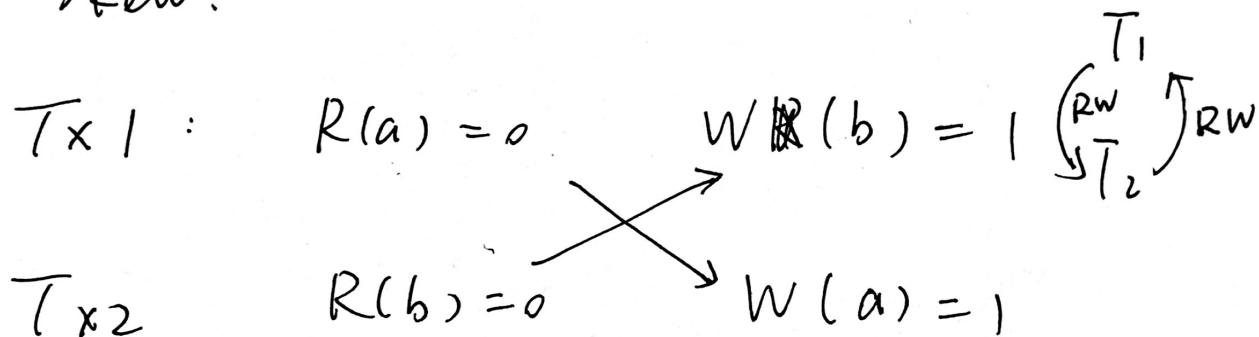
# Read Skew

$Tx1$ :  $\underline{R(a)=0}$                                $\underline{R(b)=1}$

$\searrow$ rw                                    $\nearrow$ wr.

$Tx2$ :  ~~W~~        $W(a)=1$   $W(b)=1$
                                                        C

# Write Skew.

$Tx1$ :  $R(a)=0$              $W\cancel{R}(b)=1$   $\left(\begin{smallmatrix} T_1 \\ RW \\ \downarrow T_2 \end{smallmatrix}\right)RW$

$Tx2$   $R(b)=0$              $W(a)=1$

$ts=1$ 

$a=0 \big|_{ts=1}$ ~~b~~

$b=0 \big|_{ts=1}$

$ts=2.$ $Tx1.$ $ts=1$ $R(a)=0 \big|_{ts=0}$

$R(b)=0 \big|_{ts=0}$

$ts=3$ $Tx2.$ $ts=2$

$W(a)=1 \big|_{ts=2}$ . $W(b)=1 \big|_{ts=2}$ C

$b \begin{cases} \underline{ts=0 \quad 0} \\ ts=2 \quad 1 \end{cases}$

$Tx3 \big|_{ts=0}$ ~~W~~ $W(a)$

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~~$ts=1$~~

~~$as=1$~~

$Tx1:$ ~~$ts=1$~~

$(R)\, as=1$

$W(a)=2 \big|_{ts=2.}$ ~~$R(a)$~~

$Tx2:$ ~~$ts=2.$~~ ~~$W(a)=$~~

$(R)\, as=1$ $R(a)=0 \big|_{ts=0}$

$R(a)=0 \big|_{ts=0}$

~~$as=2$~~ |

$as=1$

$as=2$

| | Dirty Read | Fuzzy Read | Read Skew | Write Skew |
|---|---|---|---|---|
| Read Uncommited. (No read locks) | P | P | P | P |
| Read Committed. (Short read locks) | NotP. | P. | P. | P. |
| Repeatable Read. (enforce ) | Not P. | Not P. | P. | P. |
| Snapshot Isolation (timestamp read) | Not P | Not P | Not P. | P. |
| Serializability. | Not P | Not P | Not P | Not P. |

Sees a different value then abort.

Stored procedure ⇒ release locks if no reads.

$a = 100$
$b = 0$

Tx 1.
(Transfer)

read $(a) = 100$   $R(b) = 0$   |   $W(a) = 0$   $W(b) = 100$

Tx 2.
(withdraw)

read $(a) = 100$   |   $W(a) = 0$

$T_1$ ⟩ wr

( rw

$T_2$   (WW)

Defaut   S.I. / Seri----

Oracle.